POPULAR SCIENCE

FOUNDED MONTHLY 1872

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RISES FROM TRACK
AT HIGH SPEED
Page 34

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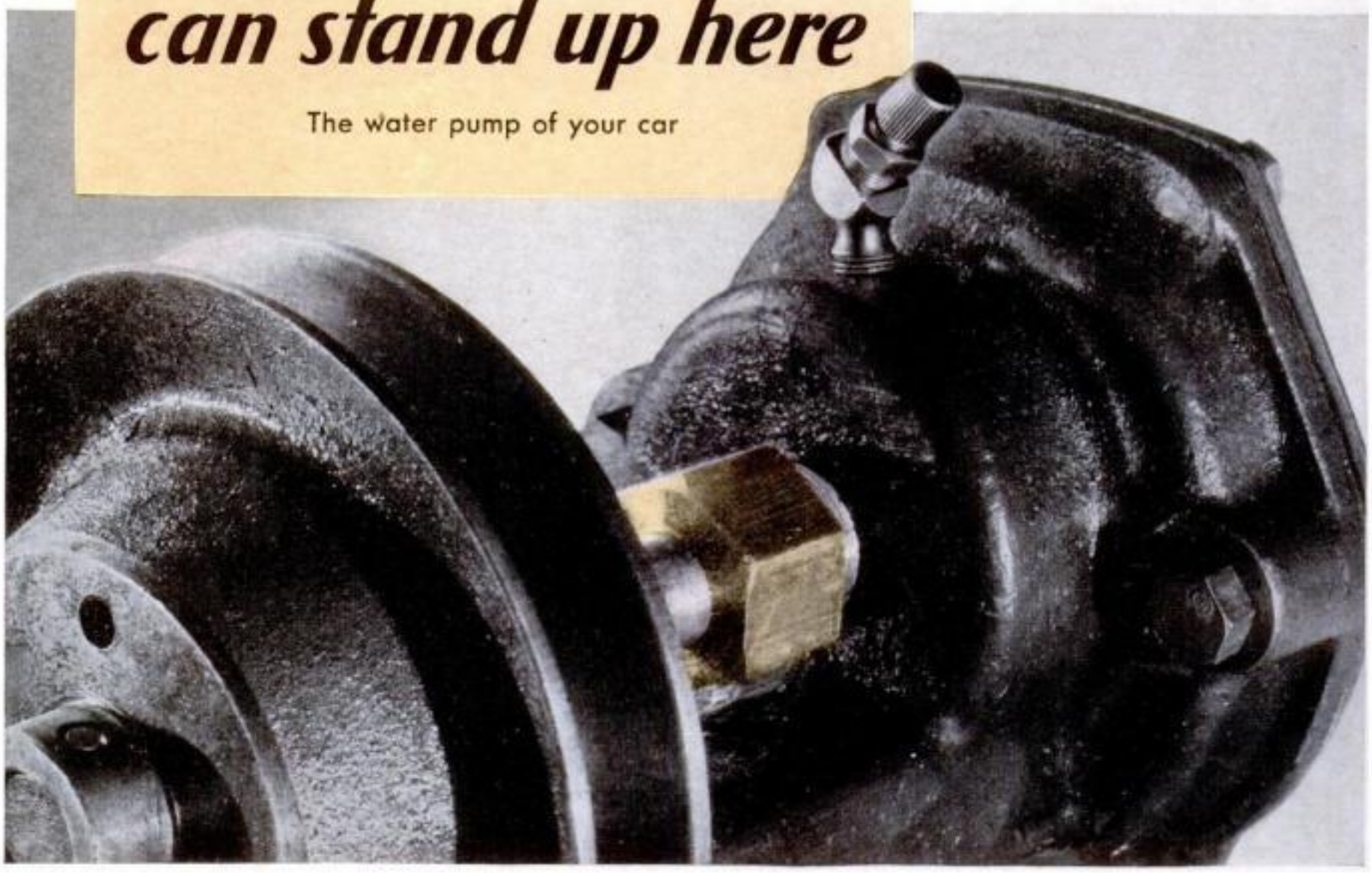

Water pump lubrication is the key to engine cooling. Many a radiator has been clogged through faulty pump lubrication. Only a special lubricant can stand the attack of hot water. Texaco Water Pump Grease is 100% water-proof. This is one of the specialized Texaco Lubricants used in Texaco Certified Lubrication.

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SEE FOR YOURSELF *with* MARFAK NO PART OVERLOOKED

Across the miles comes a WELCOME VOICE

IT MAY be the voice of a son or daughter away at school. Of a mother or father in a distant city. Of a friend or neighbor who is wondering how you are. Of a business associate upon whose quickly spoken words some great decision rests.

Across the miles, the telephone brings those voices to you and carries your voice in answer. A bell rings and you reach out your hand, knowing that somewhere—near or far—another hand is reaching toward you.

The telephone enlarges the lives and opportunities of all who use it because it enlarges the power to communicate through speech. Contacts with people, ideas exchanged, words spoken—by these are our minds stimulated and the entire business of living made more pleasant and productive.

Because the telephone is so important to so many people, the Bell System strives to make its full usefulness available to every one, everywhere, at all times. Always it tries to emphasize the close contact between each telephone user and the unseen men and women who make good service possible. Always it aims to serve with courtesy, dispatch and sympathetic understanding.

Your telephone offers you the service of a friend. At any hour of the day or night, you have but to turn to it to command as many as you need of the Bell System's army of carefully trained workers.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

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POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 122 · NUMBER 5
15 Cents a Copy · $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
381 Fourth Ave., New York

TABLE of CONTENTS for MAY, 1933

May, 1933, Vol. 122, No. 5. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

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FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

POPULAR SCIENCE MONTHLY for MAY, 1933

ENGINEERING

MODELS

NEW PROCESSES AND INVENTIONS

PHOTOGRAPHY

UNUSUAL FACTS AND IDEAS

FOR THE HOME OWNER

WOODWORKING

IDEAS FOR THE HANDY MAN

HINTS FOR THE MECHANIC

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Money . . .

WHEN YOU NEED IT MOST

By LEON MEADOW, *Financial Editor*

IT HAD been a good dinner Francis Gordon reflected. But then the Barringers always served good dinners, he remembered.

Norman Barringer came back into the living room. "Now that I've put the girls to work in the kitchen," he said to his guest, "we'll have time for a quiet little chat before the bridge war begins. I wanted to ask you something . . . . oh yes, I remember now. Tell me, Francis, what's all this I hear about Financial Independence Week? I've seen some posters ballyhooing it—but what is it?"

Gordon lit a cigarette before answering. "All the life insurance companies in North America have joined forces in observing a Financial Independence Week, from April 15th to 22nd, for the purpose of widening public understanding in its fundamentals."

"Life insurance companies?" questioned his host.

"Why not—who has a better right to undertake that necessary job? Few, if any, other types of financial organizations in the world can match the record of life insurance companies in 1932. They paid policyholders and beneficiaries over three billion dollars in 1932 and, I am told, had over one hundred billion dollars worth of life insurance in force for that same year. So I guess they can speak about financial independence with authority.

"As you probably know, financial independence doesn't necessarily mean a lot of accumulated money. But it does mean a secured means of living for life, and it doesn't matter whether that living is gained by a weekly salary check, by inheritance or by the home production of all one's necessities."

"Don't you feel," interrupted Barringer, "that there's a good deal of irony attached to a Financial Independence Week promoted in these times?"

Gordon laughed. "I hadn't thought of it in that way," he replied. "What I do know is that these hard times have made one thing apparent—and that is that now, more than ever before, a man can't afford to die!"

"That's a peculiar thing to say," put in Barringer. "What do you mean—'can't afford to die'?"

"I MEAN simply that it doesn't pay to die, from any angle you look at it. If a man has accumulated a large estate in bonds, stocks, real estate properties or in all of them, his death at present would leave his family with a sadly and badly depreciated estate. Not that that would always be the case," Gordon added hastily, "for the picture may well change in the future. But the only way he could make sure of keeping that estate at 'par' now would be by taking out sufficient life insurance to protect and balance losses through depreciation, and thus safeguard his program of financial independence.

"Or, if you want, take the case of the man who is the wage-earner or income producer for his family in these times. He 'can't afford to die,' for survival is hard enough with him living. In normal times his family might be able to produce sufficient income for their livelihood. Today that is next to impossible. They must be protected, and the cheapest, safest way is through adequate life insurance, or so it seems to me."

"Say, Francis, excuse me for interrupting, but you're quite an enthusiast on the subject, aren't you?"

"I've been giving it a lot of thought lately, and I've heard some interesting cases."

"Have you reached any conclusion?" Barringer asked his guest.

"ONE major one—a soldier isn't a veteran, isn't really proven until he's been under fire. He may drill nicely and all that, but the real test comes when he swings into action. Investments are like that, too. In dress rehearsal, most of them have a way of sounding and looking fine. But delivery under pressure, under adverse conditions is another thing.

"What I'm driving at is that life insurance has come out on top, has proven its value 'under fire!' What's more, I think it will emerge with new laurels. Did you ever stop to consider that most men, including myself, have always thought of life insurance as a purely future protection—as what you might call a second line of defense?"

"I've regarded it that way, too," his host replied.

"Well, I've had my eyes opened, and I'm changing my ideas on the subject. It seems to me that present conditions have proven for life insurance the claims that have long and truthfully been made for it. Namely, that it *is* first-rank protection. Men, families and businesses in varying situations are learning that life insurance, originally purchased as a purely secondary and future means of revenue, is actually enabling them to live, to keep going today; is actually a source of income now—when they need it most.

"I heard a *(Continued on page 6)*

$200 A MONTH REWARD

for taking this sensible step

WITH a reward of $200 a month for life, you can retire whenever you wish. You can sit back and take life easy with many happy, comfortable years ahead. Or you can go on to larger success, knowing that your guaranteed income sets you free to do as you please.

In either event, you will be very thankful for the sensible plan you discovered back in 1933—and for the simple step that started you on the way to such a rich reward. Fortunately, you don't have to be rich to start on the road to this security. Far from it. Thousands of men of comparatively limited means have used this plan to get rid of their biggest money worries for good.

It is called the Phoenix Mutual Retirement Income Plan. And it provides a permanent monthly income, beginning at any age you say, 55, 60, or 65. The amount of the income can be $100, $200, $250 a month, or more—any amount you wish.

All you have to do is take the simple step which starts you on the way to financial independence and then make modest payments regularly. Naturally the payments are comparatively small because they may be made monthly and are usually spread over a period of years.

And when your income begins, nothing can stop it. Nothing can delay it or interfere with it. Both the plan and the income are guaranteed to you by the Phoenix Mutual, an old established Life Insurance Company with a record for fulfilling promises which began when this company began (back in 1851).

These Benefits are Yours

If you wish, other important benefits may be included in your plan. You can provide a guaranteed income for your wife, in case anything happens to you. Money for your children's education. Money to leave your home clear of debt. Money for other pressing needs or emergencies, such as serious accident to you or illness.

A Depression-Proof Plan

A Retirement Income Plan is an ideal arrangement for the man whose financial progress has been upset by the depression. Naturally he doesn't want to repeat his experiences and, in the future, he wants to put most of his money where it will be both safe and accessible.

The minute you put your plan into effect, a great burden is taken off your shoulders. As you continue to invest, you can laugh at depressions and other things which now cause money worries. Others may lose their wealth. Great estates may crumble. But this plan unfailingly brings you your reward.

The plan is as safe as the great institution of life insurance itself. It is based on the same principles. It has the same safeguards. Every possibility has been considered. Every reasonable precaution has been taken. Even if you became totally disabled for six months or more, you would not need to worry. Your payments would be made for you by the Company out of a special fund provided for that purpose.

SEND FOR THE FACTS

Think what a Retirement Income Plan can mean to you! Protect your future? Certainly, but think what it means to you *now!* Once you have adopted it you are financially free. A great load is off your mind. Many of your biggest money worries disappear.

There is no mystery to it, no complications. It's all clearly outlined in an interesting 24-page booklet explaining what this plan can do for you. Send for your free copy today. No cost. No obligation.

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795 Elm St., Hartford, Conn.

Send me by mail, without obligation, your new book describing THE PHOENIX MUTUAL RETIREMENT INCOME PLAN.

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Date of Birth_____

Business Address_____

_____

Home Address_____

PHOENIX MUTUAL
LIFE INSURANCE COMPANY

Home Office: Hartford, Conn. Established in 1851

Money When You Need It Most

(Continued from page 4)

story the other day about a woman who was left a rather sizable estate in the form of a large lumber mill and some insurance. When times got hard her income from the mill grew smaller and smaller. When things got worse she found it necessary to dip into her insurance to cover taxes and mortgage interest on her business properties. Now the business is gone, and the insurance remains as her sole source of income. She never dreamed that would happen!

"Listen to this one. A corporation suddenly found itself choked for money when bank holidays in several states made it impossible for their branch offices in those states to operate. They fell back on their business insurance, originally taken out as a future protection only, and obtained a large enough loan to tide them over. Once more insurance, under pressure of hard times, stepped up to the front line of financial safeguards."

"That's a good way of looking at it," commented Norman Barringer. "It hadn't occurred to me before, but now I begin to see a reason for your enthusiasm. The case for life insurance is certainly a strong one."

"And so," replied Gordon, "to go back where we started, the case for life insurance's part in Financial Independence Week is also a strong one. You see, the depression has finally had the effect of interrupting most people's financial programs and, in many cases, upsetting them entirely. From the two isolated stories I gave you—and, by the way, they're typical of thousands—you can see that insurance is being regarded in a new and stronger light. More and more people are signing their own Declaration of Financial Independence these days by putting their names on life insurance policies, particularly of the retirement income and annuity types. I don't think they'll regret it. Say, here come the girls, and we haven't set up the bridge table!"

TO HELP YOU GET AHEAD

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The Investment Aspect of Life Insurance, by M. A. Linton, presents life insurance as an exceedingly worthwhile investment as well as a form of protection. Provident Mutual Life Insurance Company, of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Dependable Security of Legal Reserve Life Insurance as a Depository Institution—by S. S. Huebner, prominent insurance expert, tells why life insurance can show you how to face the future unafraid. Sent on request by Financial Independence Committee, 140 Garden St., Hartford, Conn.

"You Can Have An Income As Long As You Live," a booklet describing simply and clearly how the Annuity can be used to provide a guaranteed income for life. A copy will be sent on request to Inquiry Bureau, John Hancock Mutual Life Insurance Company, 197 Clarendon St., Boston, Mass.

STRENGTH OF INSURANCE COMPANIES REVEALED BY 1932 STATEMENTS

READERS of POPULAR SCIENCE MONTHLY who are policy holders in the insurance companies advertising in this magazine should be interested in seeing the 1932 annual statements of these companies. In general, these statements indicate a secure, sound basis of stability, and are a tribute to the wisdom and integrity which insurance companies have used in safeguarding the interests of their policy holders.

We have made arrangements with the Equitable Life Assurance Society, Phoenix Mutual Life Insurance Company, and Provident Mutual Life Insurance Company for the distribution of their 1932 annual statements to readers of POPULAR SCIENCE MONTHLY.

If you wish to have a copy of any or all of the statements by the above companies, address your inquiry to Financial Department Popular Science Monthly, 381 Fourth Ave., New York, N. Y. Your request will be answered promptly.

OUR SHIP MODEL KITS WILL START YOU ON A FINE NEW HOBBY

THERE are few hobbies—not even working out picture puzzles—that will give you so many hours of pleasure at so low a cost in the long run as building ship models. Thousands of POPULAR SCIENCE MONTHLY readers have found this true in spite of the fact that they had no previous knowledge of ships or of model making when they started to construct their first model from our plans.

Now, however, we have made it still easier to begin this hobby by providing construction kits of carefully selected materials. You no longer have to do a lot of "shopping around" to get what you want, and it is not necessary to buy excessive quantities of material or try to use unsatisfactory substitutes.

Two kits are especially recommended for beginners. One contains all the raw materials (except glue and paints) for building the beautiful model of the Elizabethan galleon *Revenge* illustrated on pages 67 and 88 of this issue. The kit is further described on page 88. Picturesque as this model is, the construction is not difficult. Do not be deceived by the costly and elaborate appearance of the finished model as it appears in the photographs mentioned. Capt. E. Armitage McCann, who designed it from original historic sources, kept in mind the needs of the beginner at every stage of the construction, and he used all the resources of his many years' experience to simplify the various details including the rigging to such a degree that the inexperienced model maker would find the work relatively easy. Each kit is accompanied by four blueprints showing all parts full size. These alone would cost $1 if purchased separately.

The second kit that has been designed chiefly for beginners contains the sawed out hull and materials (except paints) for a 12 in. long miniature model of the new American liner *Manhattan*. It is illustrated on page 88. Because it is so very small and simple, the model can be made on the kitchen table—or in the living room, for that matter—with a pocketknife, a safety razor blade, a pair of small-nosed pliers, a file, and, if available, a fret saw or jeweler's saw.

Popular Science Homecraft Guild, 381 Fourth Ave., New York, N. Y.

☐ Materials for building a 25 in. long model of the galleon *Revenge*, for which I enclose $6.75 (or $7.25 with the hull blocks fully shaped)
☐ Materials for building a 12-in. miniature model of the liner *Manhattan*, for which I enclose $1.00

Name .....

Address .....

City ..... State .....
(Print very clearly)

Note: The *Revenge* kit is 50 cents higher west of the Mississippi River because of heavy shipping charges. If desired C. O. D., there will be an extra charge of 28 cents. The *Manhattan* kit is not sent C. O. D.

IT'S EASY TO OWN A CANOE FOR YOUR CAMP

THE first, low cost on an Old Town Canoe is the last cost for many seasons. Hard use doesn't harm it. Months out of water won't shrink it or crack it. There are no expensive repairs—no up-keep costs. Old Towns are built to last. Tough, light cedar hull is covered with durable, non-leak canvas.

You don't know the full pleasure of out-of-doors until you own an Old Town for fishing and exploring and for overnight trips. They're easy to paddle . . . convenient to carry . . . simple to ship. 1933 models lowered to $55. Write for a free catalog. It shows paddling, sailing, sponson, and square-stern types. Also outboard boats, including big, fast, all-wood seaworthy ones for family use. Rowboats and dinghies. Write today! Old Town Canoe Co., 495 Fourth St., Old Town, Maine.

"Old Town Canoes"

IT'S EASY TO MAKE BIG SPARE TIME MONEY

Send for our free plan on how to make $5.00 to $15.00 a week in your spare time by taking orders for POPULAR SCIENCE MONTHLY from your friends. No selling required. Turn extra hours into extra dollars.

POPULAR SCIENCE MONTHLY
381 Fourth Ave. New York, N. Y.

INDEPENDENCE Fund presents a new thrift program. All payments go direct to a Trust Company, which acts as your trustee according to the terms of your Trust Certificate. If you can afford to put aside as little as $10 a month, send the coupon for the free booklet, "35 Questions—36 Answers," and learn the advantages of this plan.

Independence Fund of North America, Inc., One Cedar Street, New York, N. Y.

35 Questions 36 Answers

Independence Fund of North America, Inc., One Cedar Street, New York, N. Y.

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Street .....

City ..... *State* 17V113

"We were ready to sell our house. It got so stifling hot in summer—and was almost impossible to heat in winter . . . We didn't know what to do until we read your book."

—A TYPICAL USER

Send for this book—FREE

"WE had never stopped to think that the walls of our house were *hollow*, nor that heat—and cold, and even drafts—passed through them like water through a sieve.

"We knew the *attic* got stifling in the summer, but we didn't know *how* that heat got into the bedrooms so easily.

"And we never even guessed that a fireproof *wool*, made from *rock*, could be 'blown' into those hollow walls and empty attic spaces . . . and would protect us against heat and cold as effectively, to quote your book, 'as a stone wall 10 feet thick.'

"A year ago we put in J-M Rock Wool Insulation—throughout! Our fuel bills dropped 22%. The house could really be kept warm and free from chilly drafts all winter. And last summer it stayed 15° cooler than outside—even upstairs!"

The booklet below tells how J-M Rock Wool Insulation will save *you* money—make your home more comfortable. Mail the coupon for this booklet and full details of the J-M Deferred Payment Plan—now!

JOHNS-MANVILLE
22 E. 40th Street, at Madison Ave., New York City. Dept. IPS-5.

Please send me your FREE booklet and J-M Deferred Payment Plan details, without obligation.

Name _____

Street _____

City _____ State _____

Our Readers Say

Cold Storage Experimenter Is in Need of Victims

If a fish can be frozen, put in storage, and brought back to life, what prevents the same process being applied to all species, including human beings? Think of the possibilities! Instead of putting laid-off workers on the retired list, we would put them in cold storage. Also, goodby suicides! Anybody that can't stand living in 1933 need simply order himself put on ice for ten, twenty, or thirty years. Technocrats, farmers, business men, fugitives from justice — hundreds of thousands of people would be ready customers. There's millions in it. All it needs is a little capital and a few radio crooners for experimental purposes—J. E. McL., Massillon, Ohio.

He Had a Grand Time Building an Electric Fountain

In connection with your article on electric fountain, contained in a recent issue, I offer the following idea: Popular Science Monthly can start a contest for the the best fountain and as a help to contestants, give directions for making a waterfall scene which I made some years ago. It is really more fun to make than a ship model. The frame can be made of heavy wire over which is bent wire fly screen, and cement stucco moulded into the shapes desired, or real rocks can be used. I used a pure white waterproof plaster, which is much better than ordinary cement for fine work. Indentations can be made to hold growing plants. Many stores are now selling figures of men and animals which are just suited for a waterfall and a real forest scene. —F. H., New York, N. Y.

We're Surprised That You Were at all Surprised

I have just finished looking through a recent issue of Popular Science Monthly and have been agreeably surprised. In addition to your interesting articles on Surgery, Microscopy, Chemistry, etc. there is another of L. F. Merrill's excellent how-to-make-it articles. His detailed instructions on how to make moccasins and a woodsman's pack which appeared in 1932 issues of your magazine, plus this month's information on how to make snowshoes, are three things that should be in every outdoorsman's scrap book. After searching for years in books and magazines for such instructions, and then finding them in your magazine has made it all the more valuable.—D. M., Pittsburgh, Pa.

Maybe This Is the World's Smallest Coal Mine

Popular Science Monthly recently had an article on the world's smallest coal mine which was operated by six men. About a mile west of New Castle, Colo., on the site of the old Keystone mine which was run quite a number of years ago, a mine is operated now by three men. It is located about halfway from the top of a steep hill. A cable is stretched from the entrance to the bottom of the gulch on the opposite side, on which they have a large bucket-like contraption, that carries the coal from the mine to a large wooden box, where the coal is graded.—R. Y., New Castle, Colo.

Too Much of a Good Thing Is Bad Even for Fish

I was interested in a letter in a recent issue of Popular Science Monthly which appeared under the title, "Aspirin Works Miracle in a Gold Fish Bowl." Several years ago I was stopping at a hotel in Savannah, Ga. In front of the hotel was a small pond in which were a number of gold fish. In the morning all the fish were alive and active. At noon all the fish in the pond were standing on their heads with noses in the mud at the bottom of the pool. Hotel employees examined the pond to find what was killing the fish. One of them found a tin aspirin box in the bottom of the pool. It was open and empty. Was there any aspirin in the box when it was thrown into the water? If so, did the aspirin cause the death of the fish? You might try this experiment on your own gold fish.—G. P., New York, N. Y.

Coast Guard Academy Article Wins His Praise

The article by Kenneth M. Swezey, about the Coast Guard Academy, was a corker. It should go a long way toward establishing the rightful glory of this branch of our military service. I'm glad Popular Science Monthly was the first popular magazine to recognize the importance of the new school. —D. L., McK., Forest Hills, N. Y.

Radio Beginner Pleads for First Principle Articles

I think that more readers of the Popular Science Monthly are getting interested in radio every month. I know I am, but I do not know enough about radio thoroughly to understand the articles now published in that line, and I know a large number of other readers are in the same fix as myself. In each of two late issues that I have read, three pages have been given to radio. Why not devote another full page or two, to the explanation in serial form, of the fundamentals of radio so that we beginners can take in the good articles now published. This is not a knock but a suggestion. I think your magazine is fine.—J. A. McA., Covington, Va.

Does This Solve Mystery in Speed of Light Tests?

I am greatly interested in the various surmises, published in Our Readers Say, in regard to the discrepancy in the recent light-speed experiments. It seems to me that the most obvious reason for the difference in speed has been overlooked. The new experiments have all been conducted in a tube from which most of the air was pumped. As a result, the speed of light was increased by fifteen miles per second. Doesn't that seem to indicate that the atmosphere has a greater optical density than the ether? I have long suspected this on account of the refraction of light as it enters the atmosphere of the earth. A simple way to prove whether or not this supposition is correct, would be to fill the tube with air and reconduct the tests. If the results were the same as those previously accepted, it would be conclusive proof that light travels faster in a vacuum than in air. If this turned out to be true all measurements based upon light years would be knocked out by something like 473,040,000 miles. What do others think of this?—W.W.A., San Francisco, Calif.

Probably Good, But It Sounds Slightly Involved

Our knowledge of chemistry and physics makes possible a plan for determining prices of commodities which I believe would be fair to everyone. Starting with gold in the ore, unmined, as a theoretical standard of value, let the price of each element in its ores or natural compounds be based on the relationship of gold to it in the periodic table. Let the theoretical price for gold in the ore be determined by subtracting from its price in bullion the average cost of its production. Most of the energy reaching the earth from the sun falls on water. Water is perhaps the most important substance in the life of man and other forms of life. A relationship between a quantity of water and the quantity of heat necessary to evaporate it might be made the basis for a fixed price for energy. By adding the fixed prices for chemical elements contained in a commodity to fixed prices for energy contained and ap-

plied to the production and marketing of the commodity, a fixed price for any commodity can be set. Energy and property must both be considered to have value, for the man who has no property will need to exchange energy for property. Before he can do this, both energy and property must have prices. Changing prices are not fair since they do not change evenly.—R. H., Colorado Springs, Colo.

Shallow Diving Suit Wanted by This Enthusiast

I AM enthusiastic for POPULAR SCIENCE MONTHLY. I enjoy the special departments such as the chemistry, home workshop, and automobile. W. S. of McAlster, Okla. has asked for an article on the construction of an ultra-violet transformer and I also wish to put in a request. It is for an article on the construction of a shallow diving outfit which has no suit but just the helmet. Diving in shallow water is great fun and I believe a small outfit made of scrap materials could be cheaply and easily assembled. An old copper hot water tank could be used for the helmet, garden hose for the air line, and an air pump obtained from an old automobile pump. These would supply the most necessary materials, but even so some small difficulties hinder one. An article by someone who has had experience with diving could, no doubt, smooth out the difficulties, and add some necessary details.—J. C. N., Beach Bluff, Mass.

Here's a Money-Making Plan If You Have a Camera

HERE is one "how to make money" idea, that is good. A friend of mine has a midget camera and he has an excellent way of making his camera pay. He goes for a walk through town and whenever he sees an interesting scene he snaps it, often without the knowledge of those photographed, which is possible due to the small size of his camera. Sometime it is a young mother with her first son watching toys in show window, sometime two business men having a short conference on a street corner or some of his friends walking with their girls through the park, or a respectable citizen hurrying down main street, or merry faces of children running from school. When the film is developed he enlarges the pictures into post card size and displays them in a show window. As far as I know every picture he has taken he has sold and many of them in large quantities. —P. B., West Aliquippa, Pa.

If There Are No Gas Raids Then Everybody Is Safe

I AM glad that C. A. S. isn't fooled by the propaganda that skyscrapers are safe from gas and bomb attacks by airplanes. A mock raid was tried on London to test the effectiveness of the defenses. Eighty planes attacked and every one bombed its objective and got safely away again. The only safeguard against such raids is total and universal disarmament and cooperation between nations. The only way to get these things is to work constantly for them. Stop profiteering in war munitions and the threat of war will become decidedly less ominous.—C. S., Wyncote, Pa.

Here's How the Figures Got Printed on the Eyeglasses

To J. M. H. in a recent issue concerning the figures that he saw in the eyeglasses: As you know, glass is a fluid and light is a form of energy. Light waves reflected from the embroidery, speeding toward the lenses, have a definite amount of kinetic energy, When the waves of light strike the glass, they leave an impression of the object in the glass. It is questionable, however, if electric light will do this. I have heard of lightning flashes that left an image on windows and glasses.—F. P. S., Albion, Mich.

Would You Like To See Plans for a Garden Tractor?

I AM sure a lot of your readers, as well as myself, would like you to publish plans for building a garden tractor. I believe there are a lot of old motorcycle engines that would be suitable that could be purchased cheap. Ask "Our Readers Say" and see if I am right or wrong. And remember its gardening time now.—V. B., Quincy, Kan.

He Has Trouble Telling One Saw from Another

I AM especially interested in the possibilities your magazine offers for what, I am sure, would be a fascinating hobby. I refer to novelty woodworking, small furniture making, etc. But in reading your articles I become confused by mention of fret-saws, coping-saws, scroll-saws, jig-saws, and others. I would appreciate it if you could explain to me the difference between these and the purposes for which each is used. No hardware dealer of my acquaintance seems to be able to give me this information. Some tell me they are all for the same purpose. I must admit that an examination of the tools seems to bear out this statement. I tried using a small coping saw on some one inch soft pine, but broke the blades. Was this because I didn't know how to handle the saw properly or was it because I was using too small a blade for stuff that thick? Also wouldn't a small compass saw or keyhole saw take care of a lot of curved sawing? I should like to acquire a few tools of this kind but do not know what I want or need. If you could give me a few pointers on this it would be greatly appreciated.—C. L. L., Wister, Okla.

This Ham Defends All His Short Wave Friends

HERE is a shot at W. G. W., Martins Ferry, Ohio. Are you afraid of a little work OM on the code? We hams can always welcome another to our gang. I am new myself but the more the merrier. If you and the rest of the B. C. L.'s think the QRM is bad may your guardian angel watch over you if a ham moves into your neighborhood and you get his key clicks. And don't slam us OM if some commercial broke up a good program. We hams get blamed for a lot we don't cause just because the B. C. L.'s don't know what other causes there are. Don't blame a ham until you can read his call. I often hear from people who blame a power leak on my xmiter. Hi. Come on now forget the sun lamp and get into CW ham work. Now, Editor, I have read your magazine for six years or more and I am for it. The articles by Frederic Damrau, M.D., are fine. The Model Garage by Martin Bunn, the television group and model railways are fine too. I enjoy the whole magazine but you cut the hams short in the Queer Trade Lingoes. As a ham would say your mag is T 9-7 QSA 5 R 9 es fb fm all sides. Hpe u kep going as QRT the knockers. Put John Carr on a single signal rec. OM and five meters is a good band for the experimenter. We can all use dope on it.—J. F. H., Troy, N. Y.

Claim of Seventy-Mile Speed Gets a Jolt from a Racer

I WISH to protest against the fallacy contained in an article in a recent issue of POPULAR SCIENCE MONTHLY, entitled "Sea Gull Boat Skims Water at Seventy Miles an Hour." No matter what the design of the boat, it is impossible to make seventy miles an hour with the present outboard motor for power. I speak with the experience of five years of outboard racing, during which time I have held several records. The fastest time ever made with an outboard is 58.91 miles an hour. This was made with a fifty-five horse power special racing job, turning at 6,200 revolutions per minute. The boat weighed 190 pounds and there were less than fifty square inches of bottom surface on the water at full speed. This record-breaking motor was the only one out of thousands turned out by the manufacturer that was able to turn up as fast as 6,200 r.p.m. The average fifty-five horse power motor turns up to no more than 5,700 r.p.m. I am sure any racing driver will admit the accuracy of these facts. —W. B. G., Maryville, Calif.

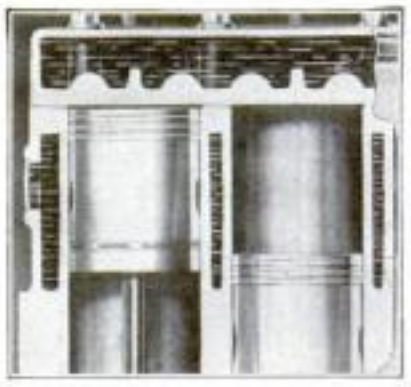
Our Mr. Ryder Taught Him, So of Course He Wins a Prize

A YEAR ago I was having trouble getting my pictures in correct focus with the camera I am using. I started reading the articles by your Mr. Ryder, Jr., each month, correcting my mistakes and trying his methods. Now, POPULAR SCIENCE MONTHLY gives me a prize for doing what Mr. Ryder taught me to do! —J. L. D., Lexington, Ky.

Here's the Mystery of a Pump With a Most Contrary Bump

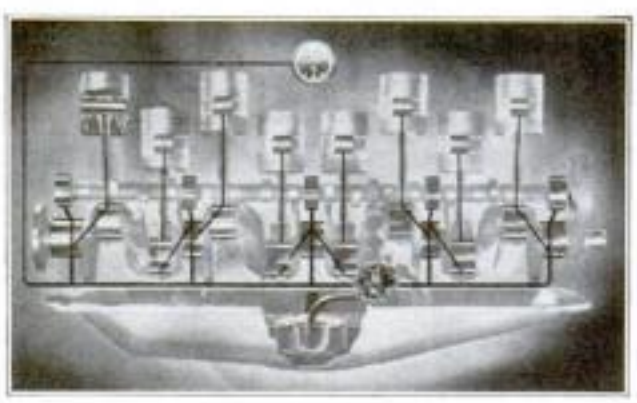
I SHOULD like to suggest to G. F. M., Mariners Harbor, N. Y., that if he has a glass bottom in his aquarium and a space under it large enough, he can either buy or make an air motor that sits on top of a light bulb and turns slowly around when the light is on. They are usually made of two or more colors of celluloid. It would make a very pretty effect but I don't know what it would do to the poor fish (the gold fish.) Now I have something myself for some wise head to figure out for me: For the last year, my pump has been acting up. It is just an ordinary iron pump with a handle on it, but if I go out after water without any water to prime it, it needs priming. If I take some water with me, it doesn't need it. It has failed only once in a year. That time it was dark. Do you suppose an old iron pump can see?—W. M. R., Jonesville, Mich.

Pontiac's Straight 8 has the longest engine built with $3\frac{3}{16}$" bore

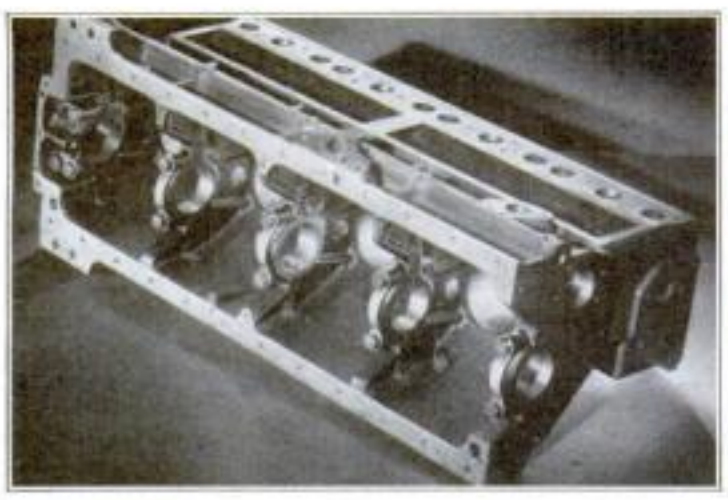


Being longer, Pontiac's cylinder block is cast with larger water space around each cylinder barrel. No danger of filling up in casting. Each cylinder is completely and always surrounded by water. This uniform cooling eliminates loss of compression and consequent loss of power, due to uneven wear from unequal expansion.

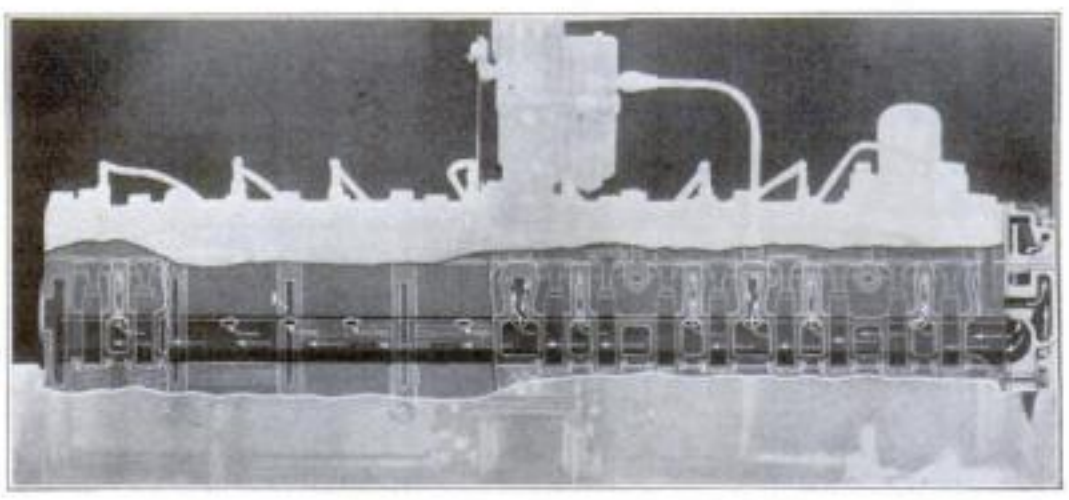
NO OTHER automobile engine of comparable horsepower (77) is as *long* as the power plant of the Pontiac Straight Eight. By lengthening the motor, Pontiac engineers have made it possible not only to cool the Pontiac more efficiently and reliably, but they were able to utilize over-size parts. This means less wear on each moving part, more strength and rigidity and resistance to the wearing effect of high speeds over long periods. Because of this, the Pontiac Economy Straight Eight is so highly efficient that it actually costs no more to operate than many smaller cars. Pontiac prices start at $585, f. o. b. Pontiac, Michigan, special equipment extra. Easy G. M. A. C. terms. A General Motors Value.



Pontiac is the most thoroughly and efficiently lubricated engine in the industry. Oil is forced under pressure to all main, connecting rod and camshaft bearings and timing chain, and through rifle-drilled passages in the connecting rods to piston pin bushings. Oil, thrown in sheets from the crankpins, drenches cylinder walls, pistons and distributor drive gears. The oil control piston ring is located beneath the piston pin—3 compression rings above.



By extending the crankcase 2½ inches below the center line of the crankshaft, the engine structure is immeasurably strengthened, while the oil pan flange also becomes the same height along all four edges. This permits an oil-tight seal at front and rear bearings. The cylinder block and crankcase are cast in one piece; five sturdy cross-wise webs on the inside strengthen the crankcase and support the five main bearings. Two heavy outside ribs running lengthwise on each side of the crankcase eliminate all possibility of crankcase distortion.



A water distributing tube running the full length of the water jacket between cylinder barrels and valve ports has holes located opposite each exhaust valve port. Cool water from the pump is circulated through this tube and delivered directly against each exhaust port. From these points it circulates around the intake valve ports, cylinders and combustion chambers and then forward through the thermostatically controlled valve into the radiator. This water distributing tube delivers cool water simultaneously to eleven points along the entire length of the engine. A variation of temperature of not more than three degrees between front and rear end of engine is thus assured. The use of separate exhaust valve ports permits circulation of water entirely around each valve seat.

POPULAR SCIENCE MONTHLY

May 1933 Vol. 122, No. 5

RAYMOND J. BROWN, *Editor*

Compton, Calif., hotel demolished in recent earthquake

When the motor starts shaking this structure, which represents a seven-story building, the four paper strips also move and electric sparks perforate them, and record movements

SCIENTISTS UNITE IN GREATEST

War *on* Earthquakes

WHEN the worst earthquake in recent American history rocked southern California, leaving its dead, its injured, and its $50,000,000 trail of wreckage, it gave to science the first accurate record of how the ground moves near the center of a violent tremor.

Only a few weeks before, new listening posts in the greatest war on earthquakes had been established in the region. Scientific traps, special seismographs, or tremor-recorders, designed to withstand heavy shocks, had been set up by the U. S. Coast and Geodetic Survey in various parts of southern California. As this is written, experts are studying the records, examining the effects of the more than thirty distinct shocks that sent buildings crashing to the ground in twenty towns and cities.

In these records, they hope to find facts that will help them pull the teeth of earthquakes by designing buildings proof against their shocks. The California disaster, bringing the menace of earthquakes once more into the spotlight, is spurring on the efforts of the American scientists who, in observatories that form a battle-line from coast to coast, are seeking to plumb the secrets of their mysterious foe.

For earthquakes are not only one of earth's most terrifying dangers. They are also one of its greatest mysteries. We really know little about these tremors that come and go with dreadful suddenness and seeming caprice. What sets them off? How can their approach be determined? What can be done to reduce their menace? Such are the questions that moving beams of light, swinging pendulums, electric sparks that shoot bullet-like through strips of paper, and floors that have St. Vitus dance have been seeking to answer in various laboratory listening posts.

At the Massachusetts Institute of Technology, Cambridge; at Stanford University, Palo Alto, Calif.; at the California Institute of Technology, Pasadena, special equipment has been installed for earthquake researches. Toy buildings, tiny skyscrapers, rocked by the quakes of the laboratory, reveal the requirements of shock-proof structures.

By ANDREW R. BOONE

During the series of shocks that rocked Los Angeles, Calif., recently, this building was demolished. Note walls are crushed as though by force of an explosion

In western states, the new-type seismographs that trapped the record of the Los Angeles tremors, were planted on dams and bridges and in the basements of buildings. Other instruments of the same kind keep watch in New England and the Middle West. Eventually the Coast and Geodetic Survey plans to dot the country with these automatic record-keepers.

And this is no mere theoretical research. It has vital, practical application to protecting life and property in the United States. Southern California is not the only part of the country where earthquakes are possible. Cutting, like great scars across the map of North America, are geological fault lines, weak places in the crust of the earth, where rock strata have slipped in the past and where tremors are likely to occur. Geologists have plotted the exact location of these lines of weakness and have found that some of our largest centers of population lie along their course.

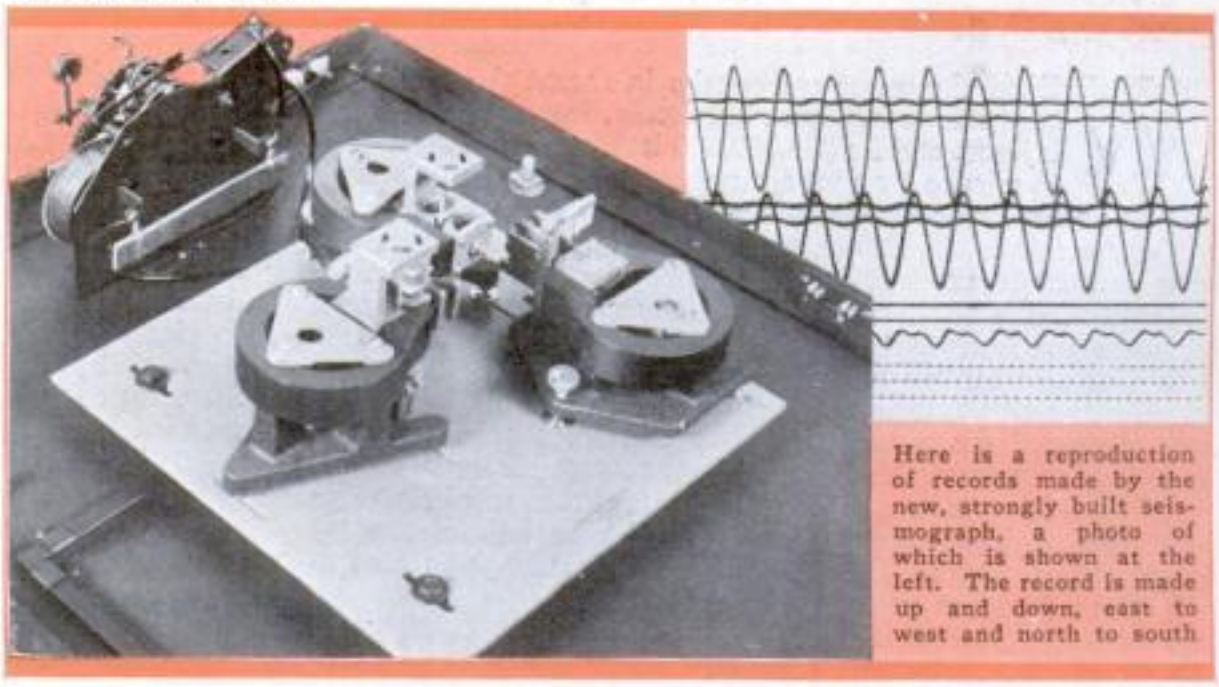
One line, running down the Atlantic coast from Labrador and the Greenland Sea, passes close to Boston, New York City, Philadelphia, and Washington, D. C. Others cut across the Great Lakes, cleave the Mississippi Valley, swing across the Southwest and follow the Pacific coastline from Alaska down to Lower California.

Chicago, Ill., New Orleans, La., as well as Los Angeles and San Francisco, Calif., are crowded centers of population situated in parts of the country where earthquakes are always possible. Other fault lines run half around the world. One circles it from the Aleutian Islands, off Alaska, down through Mexico, South America, the South Polar continent and back up through New Zealand, Tasmania, Australia, Japan to the Aleutians again. Such knowledge spurs on the scientists.

Up to a century ago, even strong earthquakes were attributed to the falling of masses of rock from the roofs of subterranean caverns. We now know they are caused by slipping of the earth's crust. The earth's hard outer skin, about forty miles thick, is under constant terrific strain. At intervals, layers in this strained crust snap and move a little. Each snapping means an earthquake.

Places of greatest strain lie between mountains along the coast and deep valleys under the ocean. If the outer crust of the earth were molten, it would tend to flow to these deeps under the sea, the lowest points on the globe. Being hard, it resists the tendency. This adds to the strain. The great 34,210-foot deep off the coast of Japan has much to do with the frequent tremors which rock that island. Until a few weeks ago it was thought to be the lowest point on earth. Then Amer-

This is one of the Long Beach streets littered with debris following the recent heavy quake



Here is a reproduction of records made by the new, strongly built seismograph, a photo of which is shown at the left. The record is made up and down, east to west and north to south

ican oceanographers reported a sounding of 44,000 feet, or eight and three-tenths miles, north of Porto Rico, in the Caribbean Sea.

An average of 9,000 earthquakes a year are registered by seismographs scattered throughout the globe. Of this annual average, 5,000 are strong enough to be felt, 107 damage buildings. A world-shaker of the first rank, such as struck southern California, occurs, on the average, every eighteen days. Fortunately, most of these major quakes take place under the sea or in relatively uninhabited regions. of the globe.

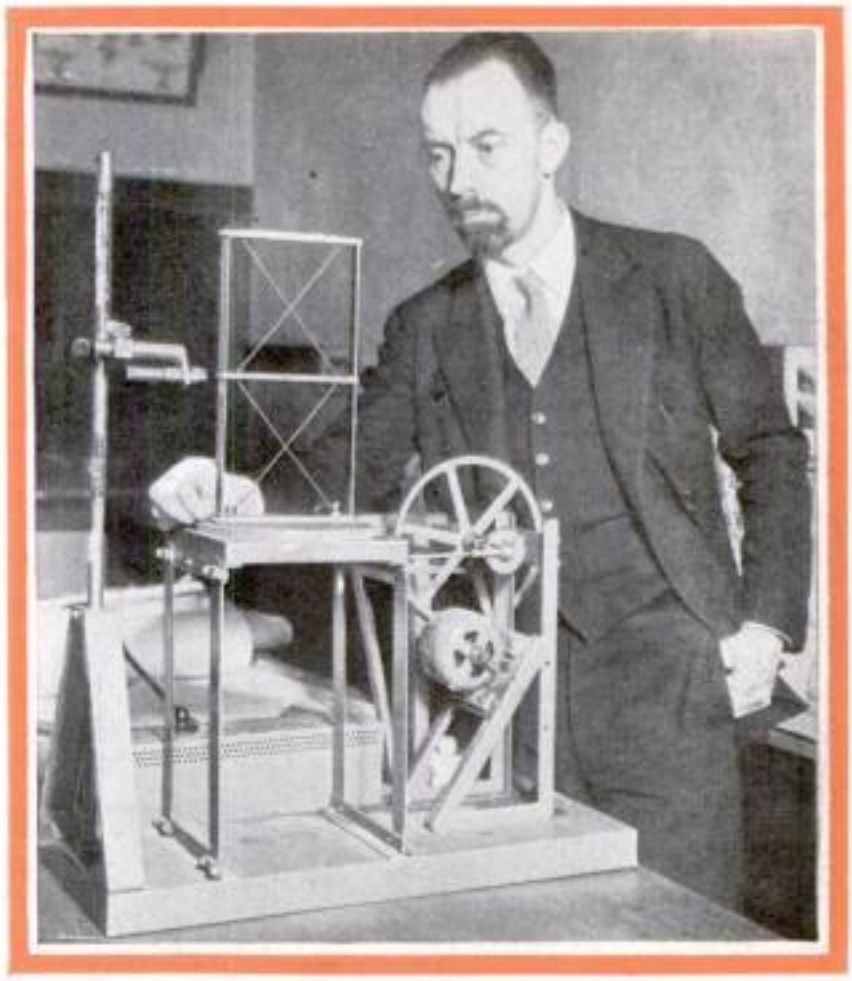
However, this is one of the reasons we know so little about them. To obtain accurate observations, records must be made near the center of disturbance. A hundred miles away, the vibrations are not the same as at the point of greatest violence. As the earthquake waves race through the rock, they pass from one type to another. In changing from, say, granite to limestone, the shift in pace is so sudden that the waves are sometimes reflected back to their point of origin.

Many of the thirty-five tremors which shook cities in southern California were formed by reflected waves running through the rock layers. Such echoes often produce more damage than the original shifting of the earth's crust.

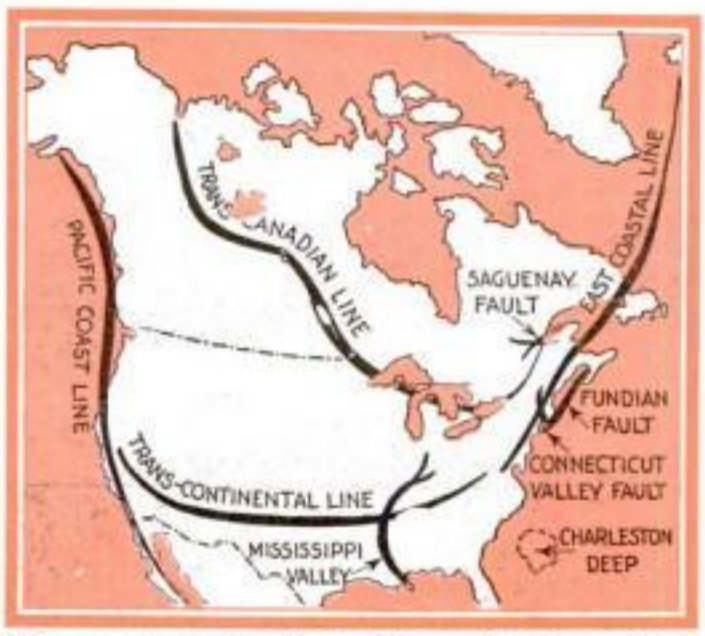
Often in the past, the delicate seismographs which picked up far-away tremors satisfactorily were jarred out of commission by a heavy quake, just when their record would have been most valuable. So, up to the time of California's quake, no records were available for study which showed exactly how the earth rocked at the center of violence during a major disturbance.

Preliminary examination of the data collected during the shocks on the west coast reveal that at times the tremor waves seem to run forward in circles giving the buildings a swirling motion. At other times, they have a snap-the-whip effect upon the structures and at others they shake them back and forth as though they were attached to a piston.

To catch records of this kind, the seismographs of the Coast and Geodetic Survey were mademanytimes stronger than the ordinary instrument. They were designed to record a number of shocks, great tremors lasting four seconds, without resetting. Ten of them, on duty along the Pacific coast, caught movements of the earth in three directions, east and west, north and south, and up and down. In some quakes of the past, the vertical vibrations have been so severe that boulders were observed jumping up and down like peas on the head of a drum.



With this model shaking table, Prof. R. R. Martel, of the California Institute of Technology, shows how cross-bracings can be used to insure the safety of a building during a quake



This map shows the principal lines of weakness in the earth's crust in North America. Note that some of these pass through or near some of our greatest eastern cities

When the earth trembled and shook during the series of shocks in the California quake, this auto standing in the street was wrecked by falling stones and its occupants were killed

Such movements are particularly dangerous in regions built up of sand or alluvial deposits. The 1920 quake in Kansu, China, snuffed out nearly 200,000 lives when hills formed of dust carried by the wind from the Mongolian deserts plunged into the valleys and buried whole villages. Survivors told of lost rivers, buried cities, and "mountains that walked in the night."

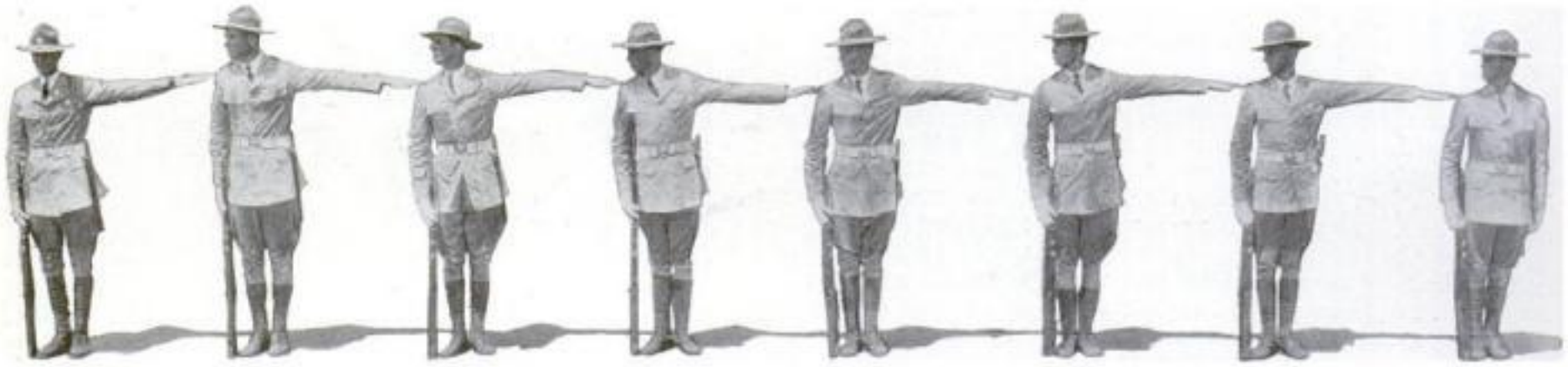
Granite, such as forms the foundation of New York City and other American centers of population, is relatively safe but not entirely immune to quakes. Geologists point to the Harlem River, connecting the Hudson and the East River and making Manhattan an island, as evidence of disturbances in the past. This river, they say, runs through a gneiss and limestone gorge formed by faulting or slipping of rock strata many years ago. The Nile and the Mississippi are said to follow similar lines of faulting.

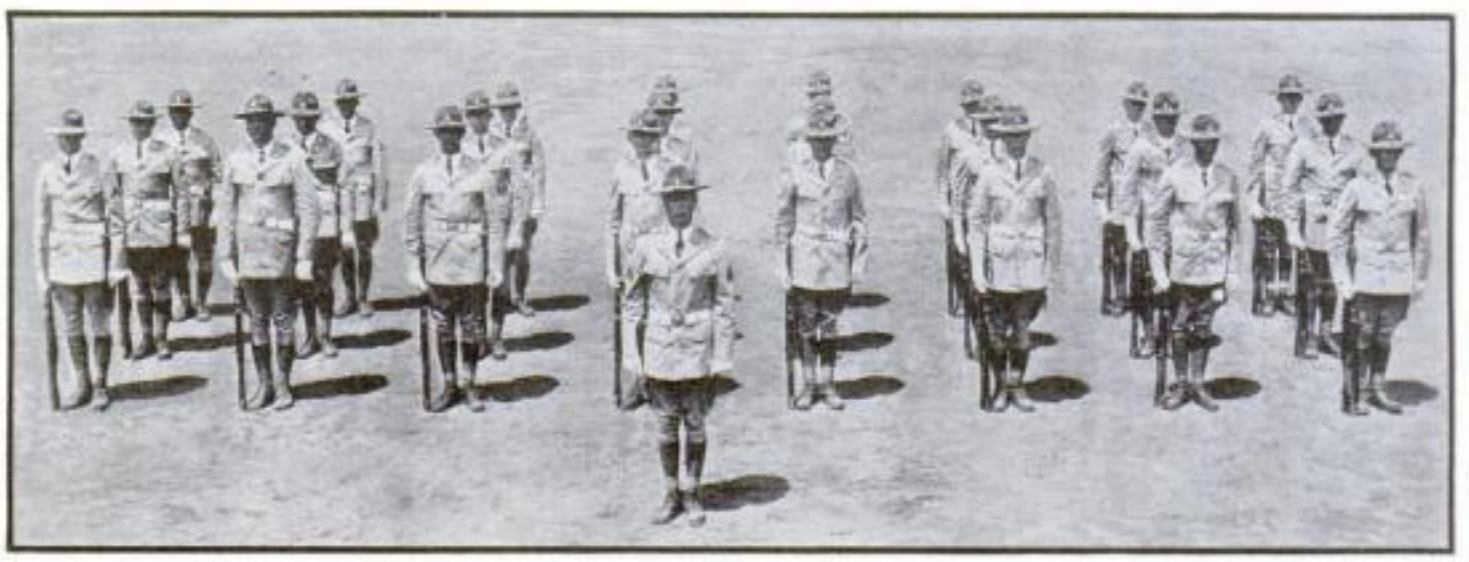
Only a few days after the Coast and Geodetic Survey had laid its trap line of strong-motion seismographs along the California coast, it caught its first record of a heavy quake. Investigation revealed that the center of disturbance was near Tonopah, Nev., a thousand miles away. The shock was computed by seismologists as even more severe than the quake that occurred at San Francisco, almost thirty years ago. Yet, because it took place far from centers of population, it caused little damage and received slight public attention.

Then came the southern California earthquake which razed cities, injured thousands and rocked an area inhabited by millions of people. Earth-tremors were again in the headlines and the work of research scientists who are seeking quake-proof structures *(Continued on page 104)*

New Army Drill

SWIFTLY TURNS ROOKIE INTO SOLDIER





Above, how new squad is formed and, at right, a section of infantrymen in the three-rank formation that is one of the features of the new drill

By Arthur Grahame

AMID-MORNING sun beat hotly down on a shadeless drill ground. Issue shoes crunched on a crushed-stone roadbed. There was a faint smell of sun-warmed oil from carefully-tended rifles.

Fifteen years of civilian life slipped swiftly away. It was the same old army—and yet how different!

To me, who used to stand in the ranks, it was strangely different and a little embarrassing to be standing with a captain in front of a company of Regular Army infantrymen who were to demonstrate for the benefit of the readers of POPULAR SCIENCE MONTHLY the workings of the new Infantry Drill Regulations now being tested by various units of the Regular Army and of the National Guard.

Quite as strange seemed the doughboys' well-tailored roll-collar uniform coats decorated with gleaming brass buttons and with insignia badges enameled in bright colors. Military science leans heavily on psychology, and it's good psychology to make a man look better, because nine times out of ten making him look better makes him act better.

Same old army? Essentially, yes! But it's an army that is full of surprises to the old-timer who has lost touch. My biggest surprise came when the captain told a corporal to form his squad.

If you shouldered a rifle in the World War, or have served in the National Guard, or have attended military school, you'll remember the squad formation. Eight men to a squad. Formed in two ranks. Four-inch intervals between men. Forty-inch distance between ranks. The corporal No. 1 man in the front rank.

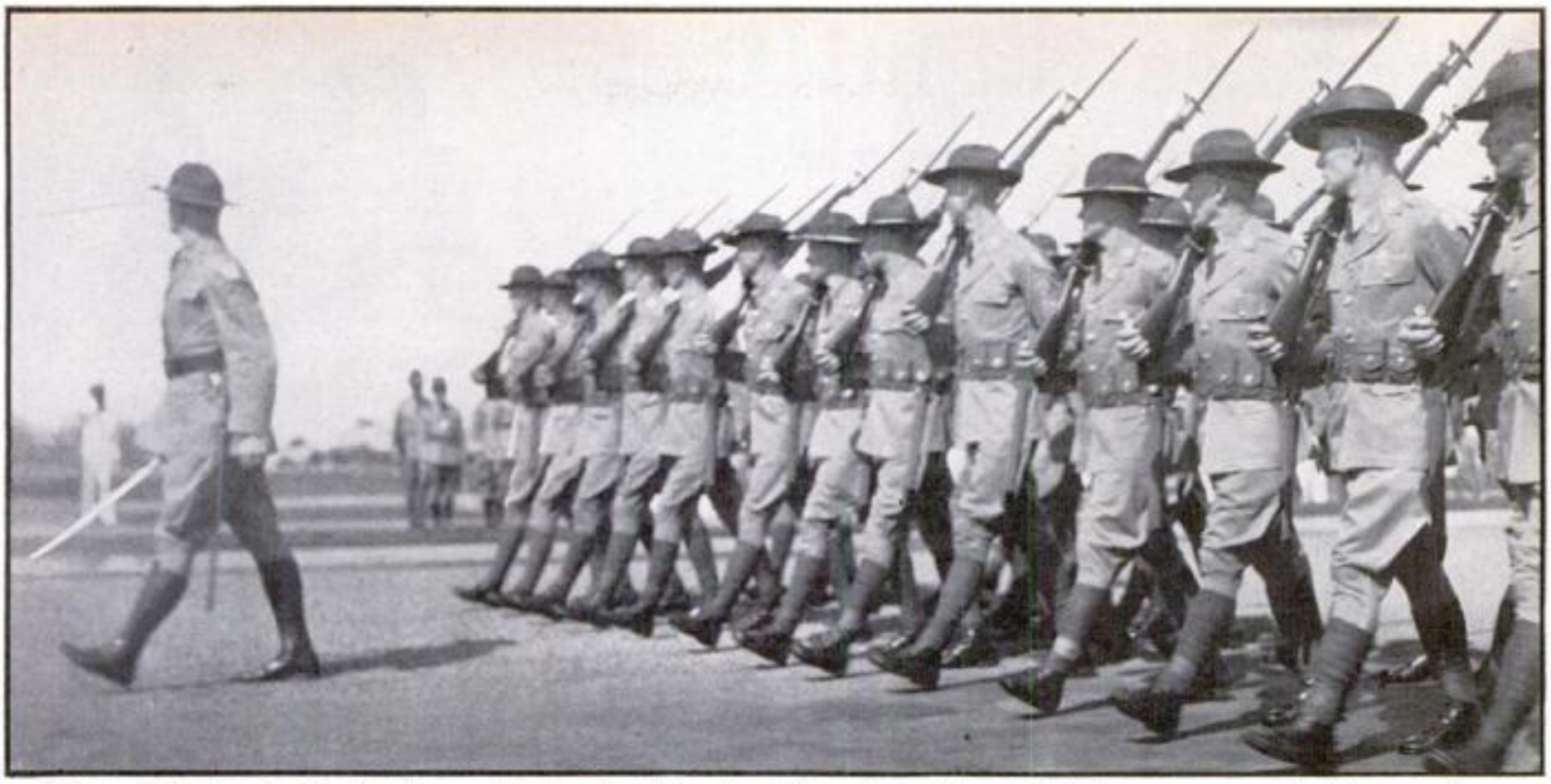
"Fall in!" The command was snapped out with the old-fashioned bark, but it was obeyed in a new way.

Facing their corporal, the seven privates formed a single rank. As he took his place, each man except the one on the left of the line extended his left arm at shoulder height, and each man, except the one on the right of the line, turned his head to his right and placed himself so that his shoulder touched the extended fingers of the man on his right. Intervals obtained in this way, they dropped their hands smartly to their sides, and snapped their eyes to the front.

Thus formed, in a single rank with intervals of about twenty-eight inches between the men, the rifle squad is the basic unit in the new-style close-order infantry drill, just as it is the basic unit of the infantry regiment's fighting strength. Organized and trained primarily as a combat team, normally the squad is composed of eight men who, from the right, form in the following order: The corporal, who is the squad leader; two scouts, armed with rifles; a rifleman; a rifle grenadier; an automatic rifleman; a substitute automatic rifleman, and a rifleman who is second in command of the squad.

The corporal put his squad through the manual of arms. There were a few changes from the old way, all made in the

A company in mass formation. This is one of the most impressive

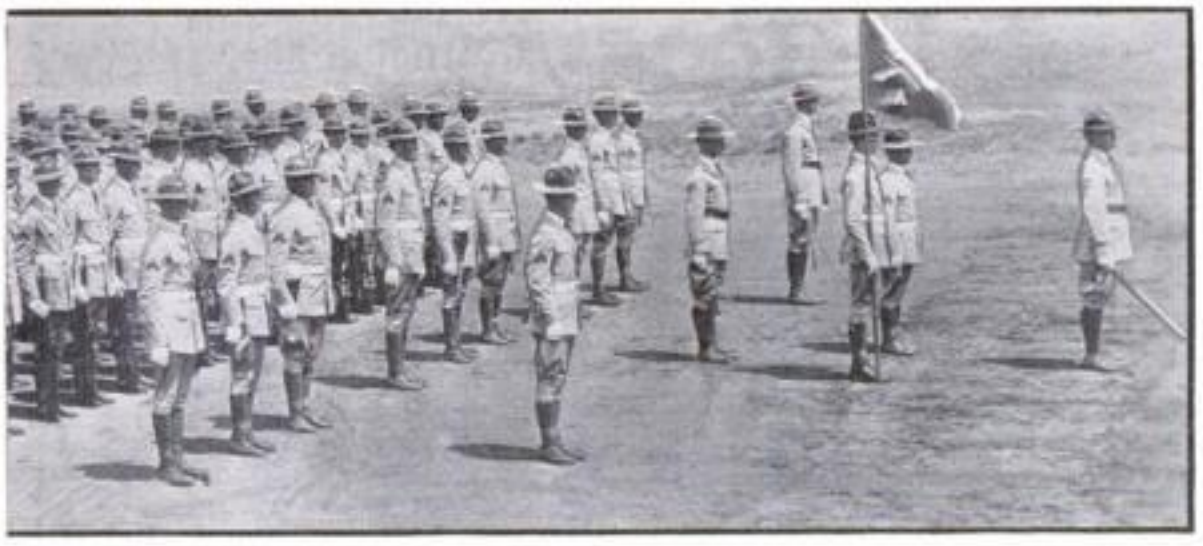


Infantry of the American Regular Army passing in review. Here the old formation is being used but the men are wearing the new uniform

Infantry Regulations Made Easy So Men Can Be Trained Quickly for Movement and Actual Combat

New platoon in mass formation which is designed principally for use in ceremonies

Photos by U. S. Army Signal Corps



of the new formations, giving the company a front of eighteen men and a depth of eight ranks

interest of simplification and comfort and the elimination of attitudinizing.

To me, the most surprising thing about the new-style infantry squad was that, in line, it nearly always marches to a flank, almost never to the front. In fact, the new Regulations authorize the forward movement of the squad in line only for short distances, and then only with trailed arms.

When the leader of an old-style squad desired to turn and march it from a halt, he gave the command, "Squad right. March!" The result was a movement complicated enough to bring many a rookie to grief, but which, when executed perfectly, was impressive in its precision.

All that, I found, is changed. The corporal commanded. "Right face. Forward, march!" Each man executed a simple right face, and then all marched forward, in single file.

A moment later, to change the direction of his squad column, the corporal commanded, "Column left. March!" The leading man faced to the left in marching, and the other men of the squad executed the same movement successively when they reached the same spot.

And that, in addition to a few easily-learned facings and side steps, was about all there was to the new-style squad drill.

The chief purpose of the new-style close-order drill, according to the new Infantry Drill Regulations, is to enable a commander to move his command from one place to another in an orderly manner, and to provide simple formations from which dispositions for fighting may readily be assumed.

Naturally, a large body of troops, such as a war-strength infantry regiment of more than three thousand men, can't march from one place to another in single file. If it did, most battles would be over before the men at the end of the column got anywhere near the firing line.

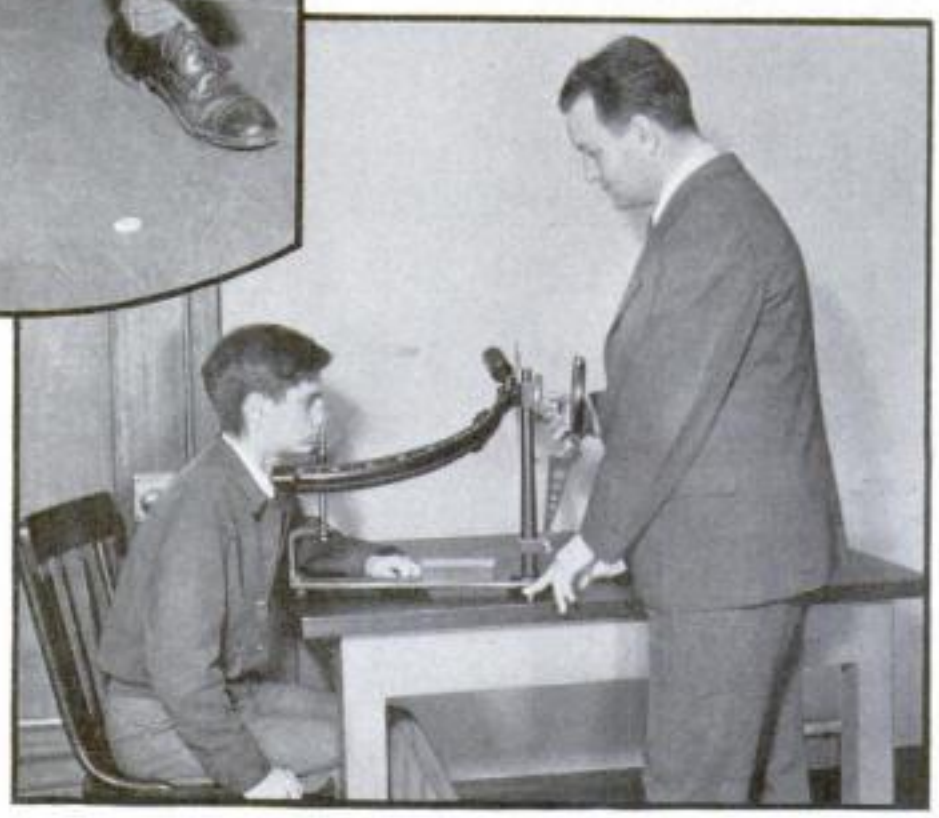
So for drill and marching, and to a lesser extent for fighting, the new-style squads are organized into rifle sections of three squads, commanded by a sergeant, with a corporal as second in command.

At the captain's order, a sergeant stepped out and commanded his section to fall in. The leading squad formed in line, as in squad drill. The second and third squads formed in back of it, with forty-inch distance between the ranks.

"Right face!" commanded the sergeant. That placed the section in a column of threes, with convenient marching distance between the ranks, but with too-wide intervals between the men. "Close, march!" commanded the sergeant. The center squad stood fast while the outside squads side-stepped to a four-inch interval. *(Continued on page 100)*

Are You Right Eyed?

YOU do not necessarily see better with the eye you use most. In novel experiments at the University of California at Los Angeles, 100 students under the direction of Dr. Lawrence Gahagan of the phychology department, demonstrated that two out of three of them, looking at an object through a tiny hole, saw it with their right eye only. The test may be conducted in the home. All you need do is cut a hole having a half-inch diameter in a sheet of ordinary paper. Place the spot cut out on the floor. Take a seat, hold the paper at reading distance from your eyes and look through the hole at the object with both eyes. Then close your right eye. If you can't see the spot with the left eye, the stunt demonstrates you are right eyed. "Everyone," says Dr. Gahagan, "is familiar with right-handedness. Ninety-five per cent of all the people in the world, whether savage or educated, are right-handed. Just so, each one has a preference in the use of his eye. Sixty-five per cent prefer the right, thirty per cent the left and the remainder seem to have no preference. Right handed people are not necessarily right eyed. Nor is the dominant eye necessarily the better one."



Looking through a hole in a piece of paper at a disk, lying on the floor, proves which eye you use in looking at an object. If you close the right eye and no longer see the spot it shows you are right eyed

In the test at right, the white dot is moved up, down, and sidewise to determine the extent of the visual field, that is, the subject's power of moving his eyes in sockets

USE PORTABLE CAMERA TO TAKE CLOSE-UPS

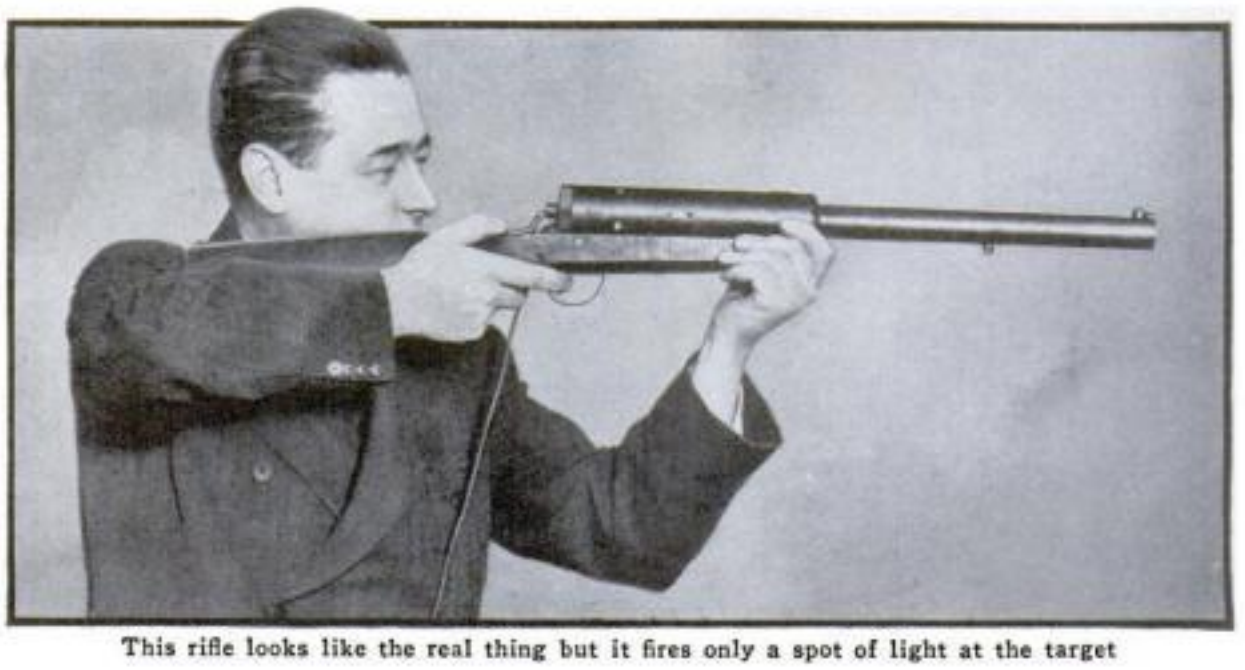
A NEW motion picture camera moves with the photographer. It is light enough to carry and the cameraman follows the subjects as they move about and takes their pictures. The camera is supported by a belt similar to that worn by a flag bearer. The machine's metal handle fits into the staff socket, an arrangement that prevents vibration while the film handle is being turned. Electricity from a trailing cable powers the camera during its use by the wandering photographer.

BOOK FITS IN COVER

CARRYING a book is easy with the purse-like cover shown at right. Set in the cover are a coin purse and a pocket large enough for railway ticket and time-table. It is also provided with a marker.

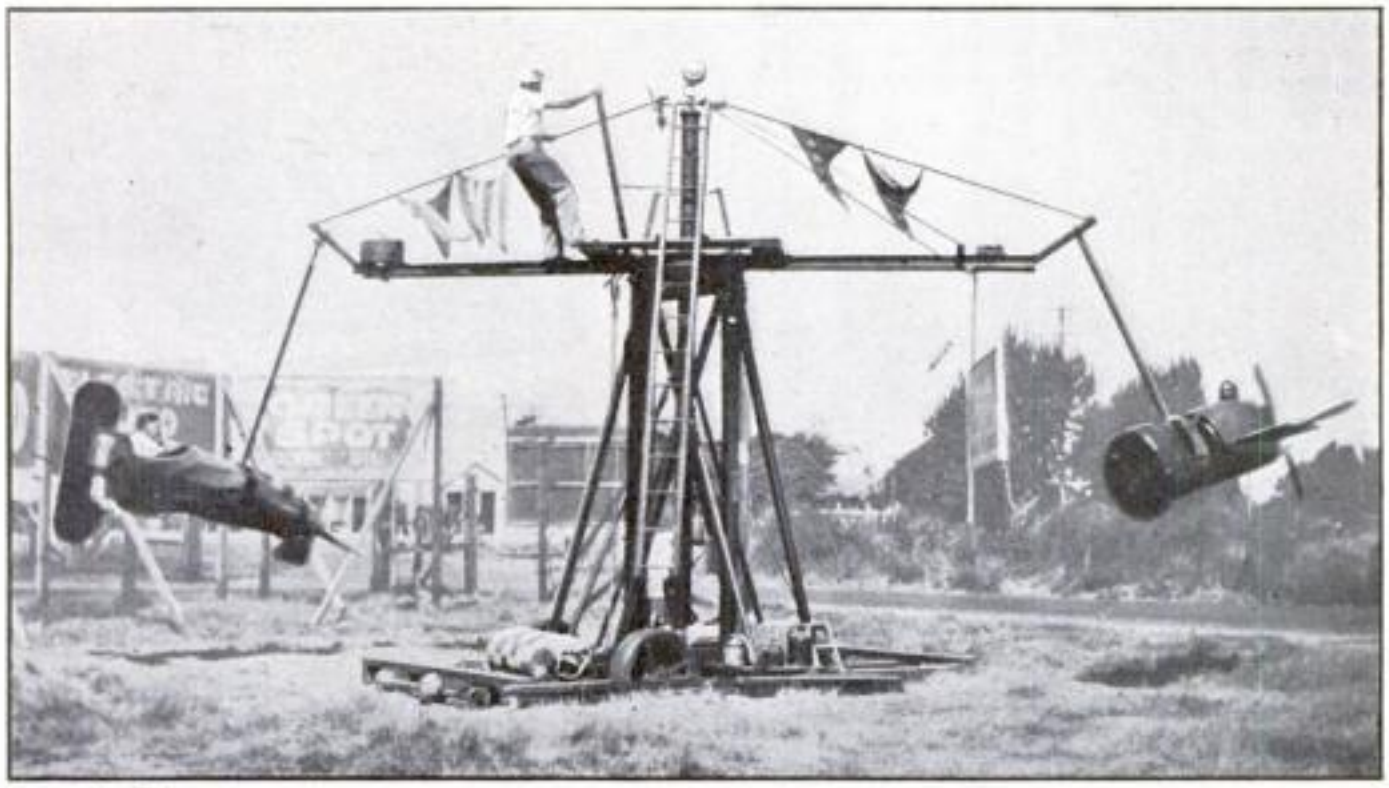
NEW PRACTICE RIFLE FIRES SPOT OF LIGHT

NERVES of recruits in the British Army are saved by a practice rifle that fires a spot of light and makes no noise. The roar of exploding powder and the crash of range rifles upset the young soldiers and subject them to severe nervous strain. To avoid this and yet train the recruits to shoot was a problem solved by the invention of a rifle, exactly like the regular army gun in weight and appearance but which, at the click of the hammer, fires light instead of a bullet. At its discharge, a black spot appears on a luminous target as a record of the accuracy of the aim. It is expected the use of the silent rifle will prove popular.



This rifle looks like the real thing but it fires only a spot of light at the target

Homemade Flying Instructor Gives Air Thrills



Two eighteen-year-old boys of Turlock, Calif., have built themselves a flying instructor that provides virtually all the thrills of piloting a plane. Passengers are strapped in two miniature aircraft that fly in circles around the supporting framework, under the power of gasoline motors, as shown at left. The baby planes are tethered to a rotating crosspiece in such a way that they are free to roll and perform other aerial evolutions at the pilot's touch of the controls. An operator riding on top of the crossbeam may apply a brake lever, or cut off the ignition, if the enthusiastic pilots acquire too much speed. Over week-ends the boys tow their device on a trailer base to nearby towns, and charge for rides.

When a tube, connected with the gage shown on the trunk, is put in the car's exhaust pipe a pointer instantly shows if the carburetor adjustment is exactly right

CARBURETOR MIXTURE TESTED BY NEW GAGE

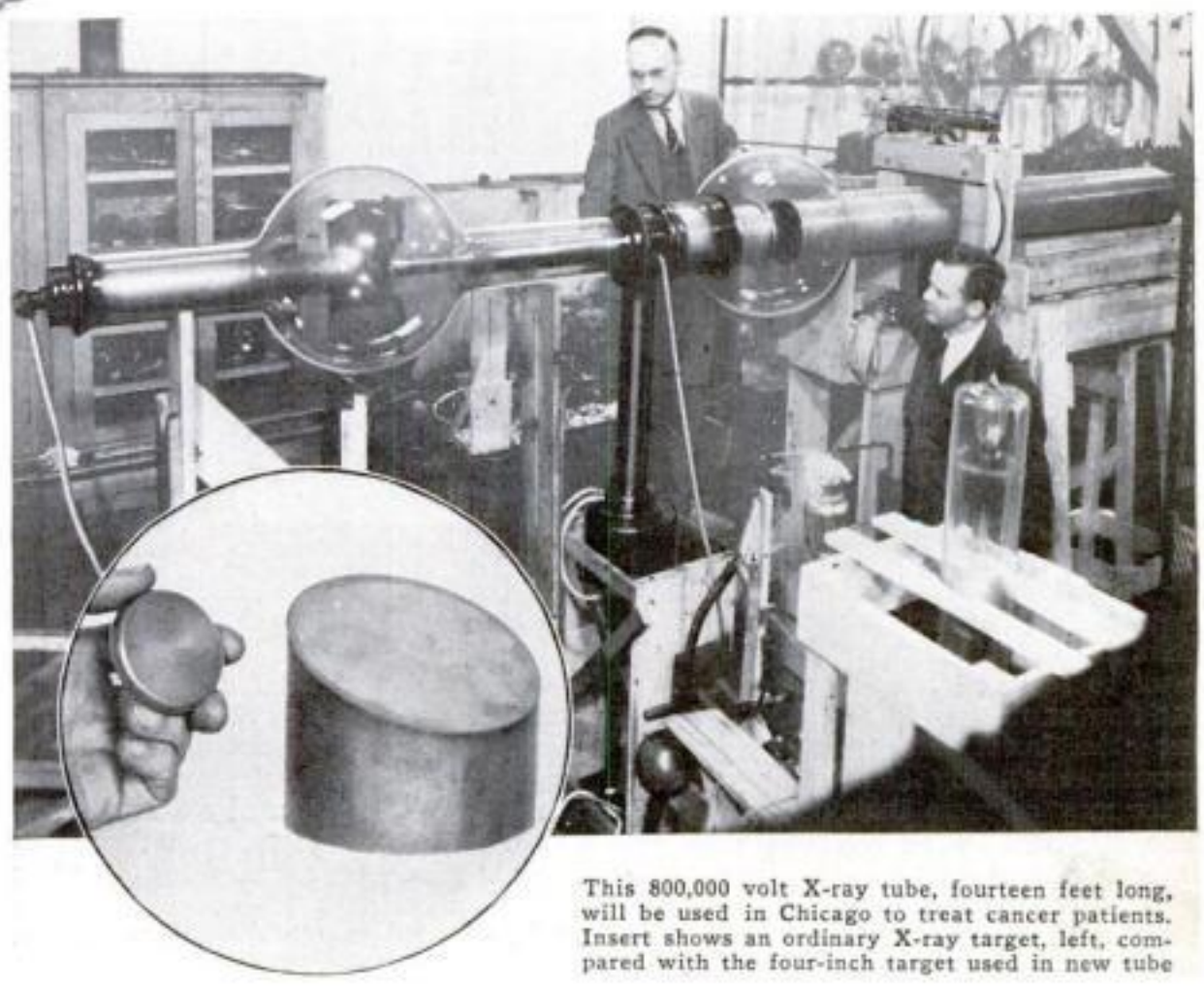
A NEW exhaust gas analyzer automatically tests the adjustment of a car's carburetor. When a tube, connected to the device, is inserted in the car's exhaust pipe, a pointer swings to "lean," "normal" or "rich." Operation of the device depends upon two sensitive wires, one sealed in air, the other exposed to the exhaust gases. The latter will lose more heat than the former if the mixture is too rich.

BOY'S WAGON ALSO PLANE OR SCOOTER

IDEAL for the boy who enjoys taking things apart is a convertible coaster wagon recently placed on the market. A wrench is the only tool needed to remodel it into any one of fifteen different shapes and sizes. A few minutes' work changes the toy from a wagon to an airplane, as shown in the photograph, or to a scooter. Models from three to six feet long may be built with the parts.

GIGANTIC X-RAY TUBE FOR CANCER PATIENTS

A GIANT X-ray tube, operating at 800,000 volts, has just been completed by General Electric engineers for use in treating cancer patients at a Chicago hospital. So powerful is the fourteen-foot tube that it is water-cooled, and its radiation is estimated equivalent to that obtainable from $75,000,000 worth of radium. X-rays are produced by the impact of a beam of electrons upon a massive tungsten target four inches in diameter.

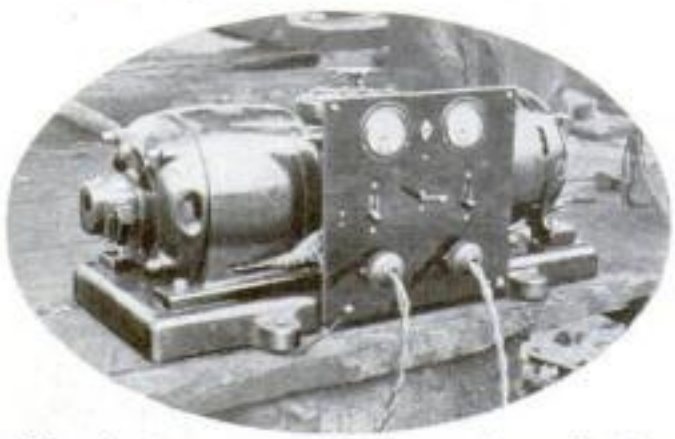


This 800,000 volt X-ray tube, fourteen feet long, will be used in Chicago to treat cancer patients. Insert shows an ordinary X-ray target, left, compared with the four-inch target used in new tube

Dead Oil Wells *made to flow by* New Electric Gun

Diagram gives the main features of the electric gun and shows how current fires it

This oil well gun, which is electrically fired at depths down to 10,000 feet, is shown here ready to be run into a California well



The electric current to fire the gun is supplied by a motor generator set which is placed on derrick floor

DEAD oil wells are brought to life by means of a new electric gun that is discharged thousands of feet beneath the earth's surface. With it holes are shot through steel pipe and cement so that oil from a zone higher up can flow into the well. The gun's .45 caliber steel bullet must pierce pipe that sometimes is nearly a half inch thick, and there may be more than one such pipe. The cement may be anything from an inch to several inches thick. Terrific explosive force is necessary and the bullet must be of hard alloy steel. It was tested recently in one of the wells in a California oil field. This well had been pumped dry in May, 1929, but a higher sand was thought to be commercially valuable. This sand, however, had been cut off permanently with two strings of pipe. The gun had to be fired at a depth of over 2,600 feet in a hole six inches in diameter. After four shots had been fired, oil started coming into the well. After eighty-seven shots, the well was producing approximately fifty barrels a day. The gun consists of a control mechanism below which is a series of firing units, each containing a bullet and powder cartridge. The bullets are pointed in any desired directions and can make the holes in the casing and cement at any vertical interval. They are fired successively or in groups, the time of firing being controlled at the surface. The cartridges can be detonated only by a thermal element heated by an electric current. The gun is run into the well on an armored cable which contains a conductor wire. When the electric circuit is closed, the current passes down the cable, through the control mechanism, to the thermal unit, and fires the shot. Direct current, supplied by a motor-generator set on the derrick floor, operates the gun which, it is said, can be fired at the bottom of a 10,000-foot well. Thus it could be used in the deepest wells that so far have been drilled.

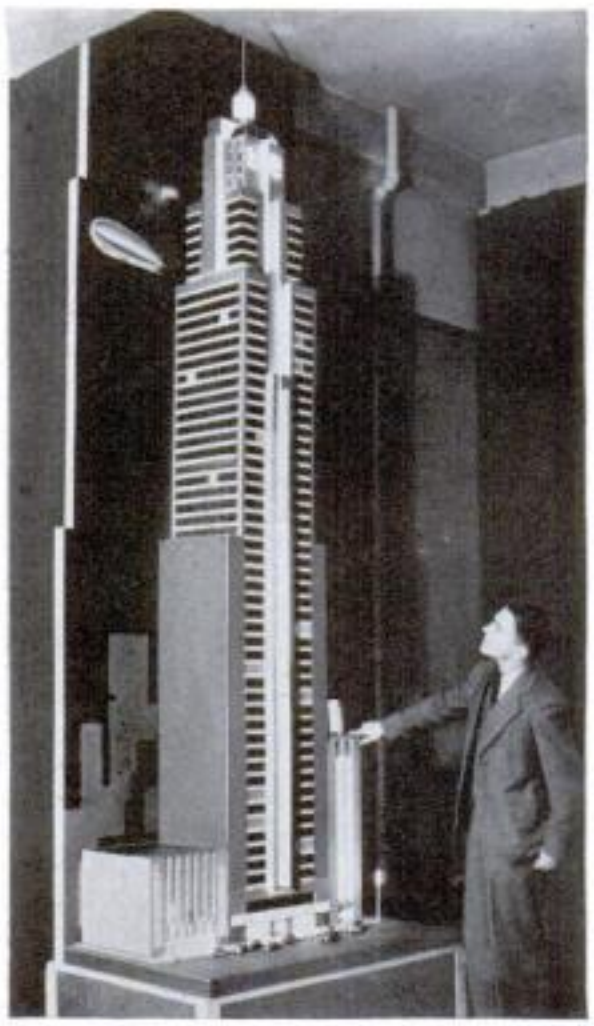
Pieces are held in place by pegs on this checkerboard, designed for use by travelers

PEGS HOLD PIECES ON THIS CHECKERBOARD

DESIGNED especially for travelers, a new checkerboard is unusually compact, although the pieces are sufficiently large to be handled with ease. The ring-shaped men fit into recessed compartments when the board is closed, and are automatically set up when it is opened for play. Each playing square is provided with a peg that holds the piece placed upon it, so that the board may be held in the lap or moved about without causing the men to slide. Kings are made by placing two pieces on one peg.

LIGHTS ADD BEAUTY TO MODEL OF SKYSCRAPER

How translucent glass panels and colored light can be used to enhance the beauty of a modern building is demonstrated in a ten-foot-high model of a skyscraper just completed at Nela Park, Cleveland, O., for exhibition at the World's Fair in Chicago. It represents a fifty-story building, accurately constructed on a scale of 1/64th of actual size, gleaming with ribbons of light and set off by colored floodlighting. Illuminating engineers foresee that such decorative effects will be widely used.



A model fifty-story skyscraper, built to scale, is lighted to show how lamps can beautify it

Eighty-Foot Fence of Mesh Guards New Golf Course

ANY mashie or niblick would have trouble lifting a ball over the twenty tons of fencing that protect the driving range of a new golf club at Portland, Ore. The barrier of chain link fabric is eighty feet at its highest point and tapers to thirty feet at each end. It is the highest fence of its kind in the United States. To secure sufficient support for the mesh, a local electric company installed twenty-four poles at intervals along the course. Cable was strung between the poles, and the fabric fastened to it.

Eighty feet high in the center portion and sloping to thirty feet at the ends this mesh fence, supported by poles and a cable, keeps golf balls within bounds

The latest puzzle fad requires that the pieces of colored wood, shown below, be put together to form a cube

BLOCK PUZZLE NEW FAD

BLOCK puzzles, distant relations of the jig-saw puzzle, are now on the market. The oddly-shaped pieces, when assembled, form a perfect cube. In the latest variant of this popular fad, illustrated above, the assembled cube is supplied in a cellophane wrapping that holds it together. Its pieces are painted different colors. By noting the pattern before taking the block apart, the novice may obtain a helpful clue to the solution.

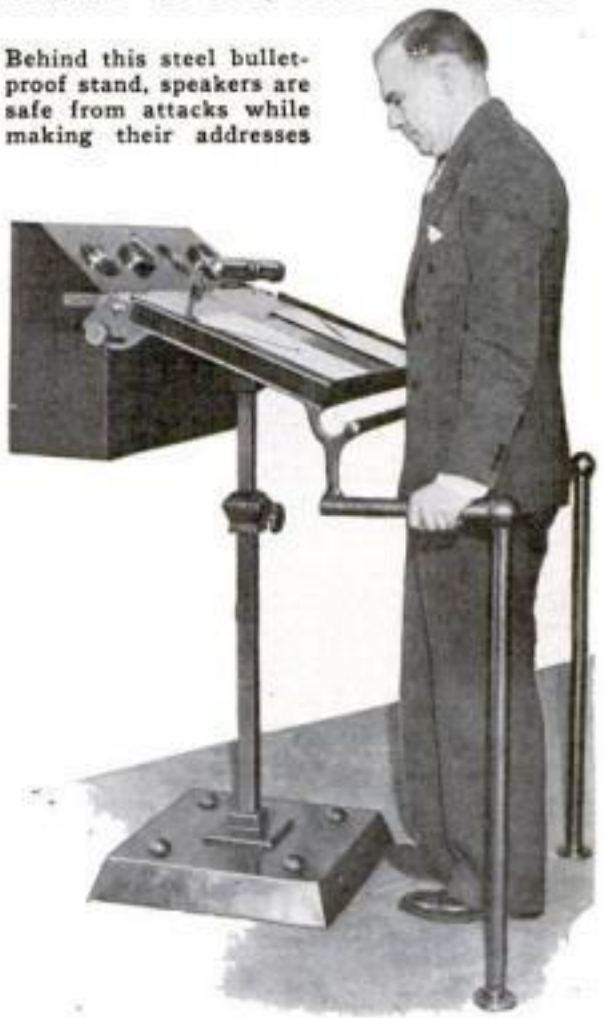
WATER TOWER PART OF TOWN'S CITY HALL

RESIDENTS of the little desert town of 29 Palms, Calif., claim that their city hall is not only the smallest in America but the most versatile—for it serves as a water tower as well. This odd structure provides a meeting place where the dozen inhabitants of the community may transact their legal and municipal business. The photograph at the left shows half the population of the strange little town reading the daily paper, which is tacked to to the wall of the building.

BULLET-PROOF STAND FOR SPEAKERS

A BULLET-PROOF speaker's desk has been devised by engineers of a broadcasting system, to protect public men from the attacks of assassins when making addresses to large gatherings. Metal armor shields the body of the speaker from below his waist to a point several inches above his shoulders, when he stands upon a platform. Four microphone outlets are spaced across a panel behind the desk, while spring clips and a lamp are provided.

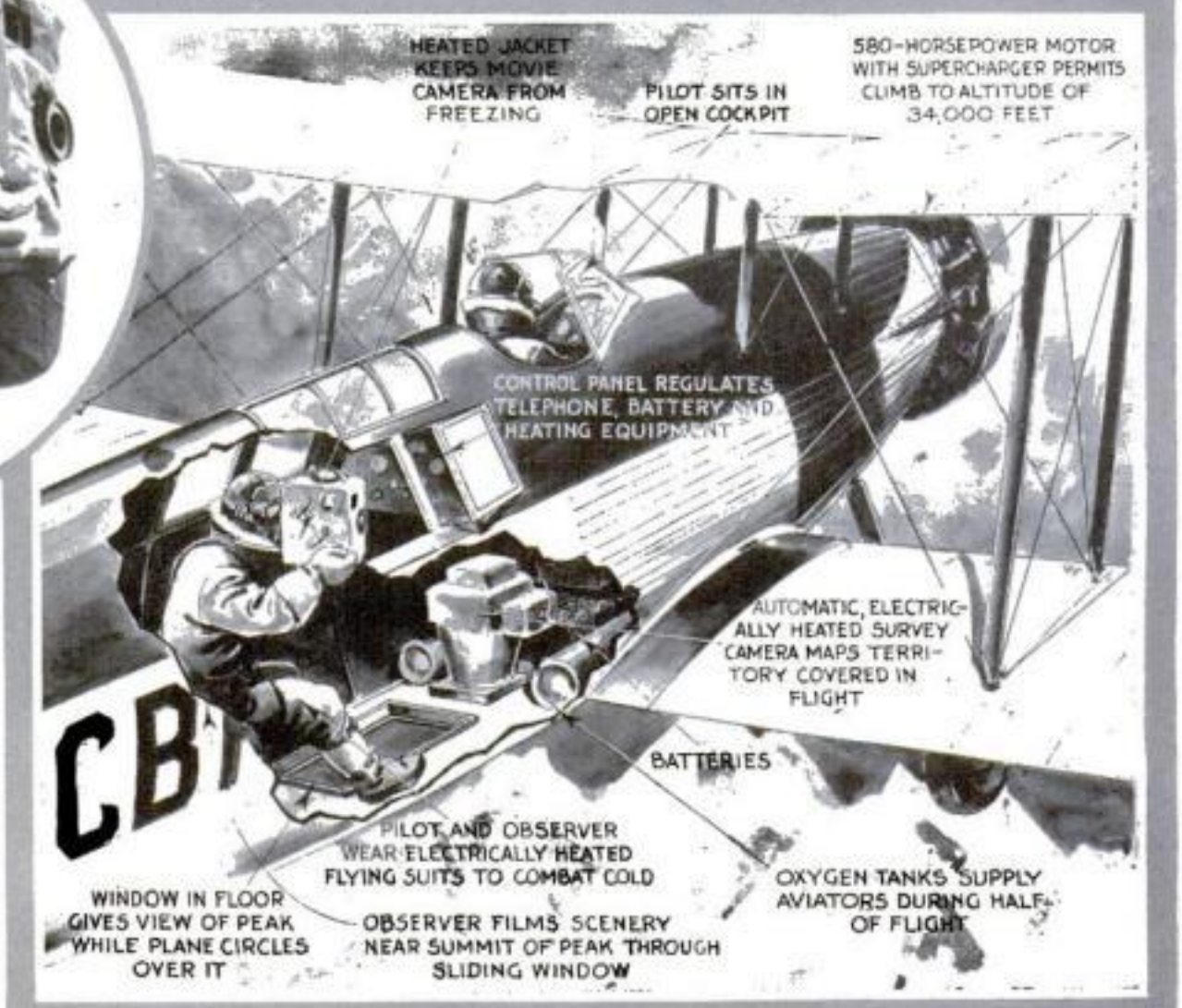
Behind this steel bullet-proof stand, speakers are safe from attacks while making their addresses



Flying Over World's Highest Peak

British Planes to Make Air Maps and Photographs of Mt. Everest

Electrically heated, covered cameras, like the one in circle, will be carried in the planes, one of which is shown above, that are expected to fly over Mr. Everest



The interior arrangement of the two British exploring planes is clearly shown in drawing

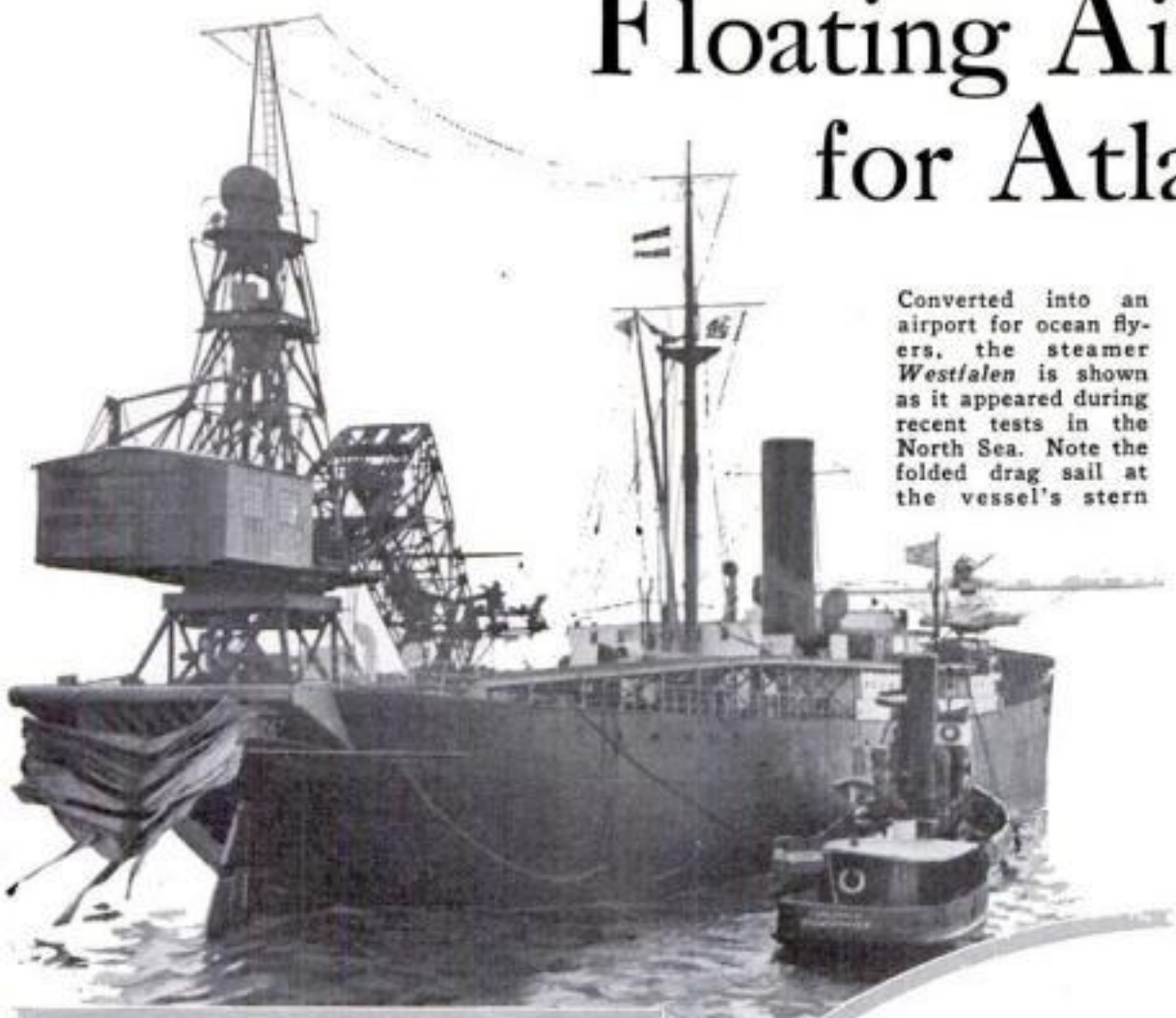
FINAL preparations were being made, a few days ago, for a thrilling aerial adventure—the first flight over Mount Everest, highest peak in the world. Two sturdy biplanes of the British expedition led by Air Commodore P. F. M. Fellowes stood poised on a runway at Purneah, in British India, ready to wing their way toward the white-capped summit. For perhaps twenty minutes the pilots planned to circle above it, in lonely triumph, while mapping and moving cameras recorded their conquest of a mountain that has defied countless generations of climbers. As this issue went to press, the world waited for news to be flashed that they had succeeded.

More than a stunt is the perilous attempt. Geographers await with keen interest the first photographs of the summit, which no man has ever seen, and of its surroundings, where dramas of heroism and tragedy have been enacted. Another and even more practical object is to show that even the world's highest peak is no barrier to traffic by air. An Everest flight may blaze the trail for future airlines across central Asia.

Flying over Everest resembles an attempt at an airplane altitude record, with the added difficulty of carrying and operating a heavy load of cameras and equipment, as the illustrations on this page show. Since the air at the summit is too rarefied to support human life, the flyers breathe through oxygen masks. Their lives depend upon keeping the valves of the oxygen apparatus from freezing. To combat the intense cold, electricity warms these valves as well as the flyers' clothing and their cameras. Superchargers, attached to the airplane engines, enable them to function in thin air. The planes are designed to reach an altitude of 34,000 feet, enough to clear the summit by 3,000 feet. From this aerial point of vantage the observers will be able to do as much in three hours, the total time estimated for the flight, as explorers on foot could do in years even if they were successful in scaling this towering peak.

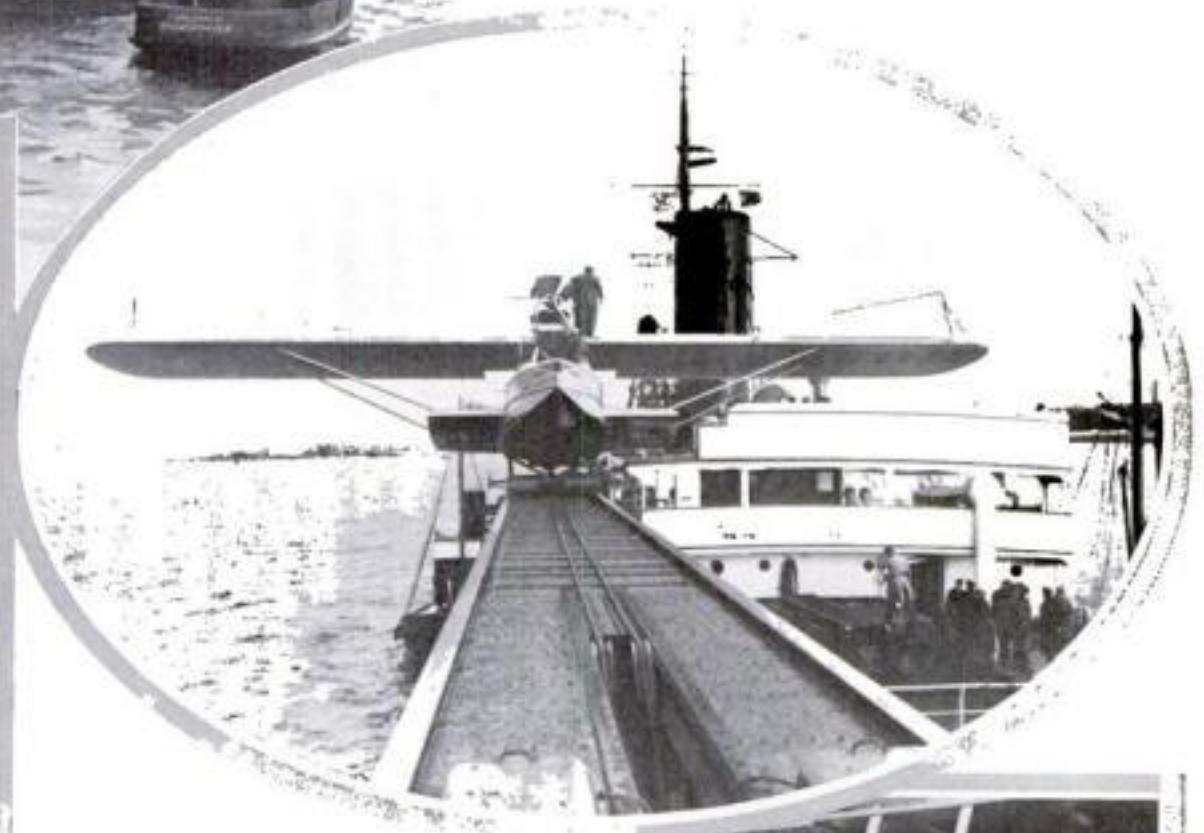
Mt. Everest flyers will wear garments like these and breathe through oxygen masks

Floating Airport Ready for Atlantic Flyers



Converted into an airport for ocean flyers, the steamer *Westfalen* is shown as it appeared during recent tests in the North Sea. Note the folded drag sail at the vessel's stern

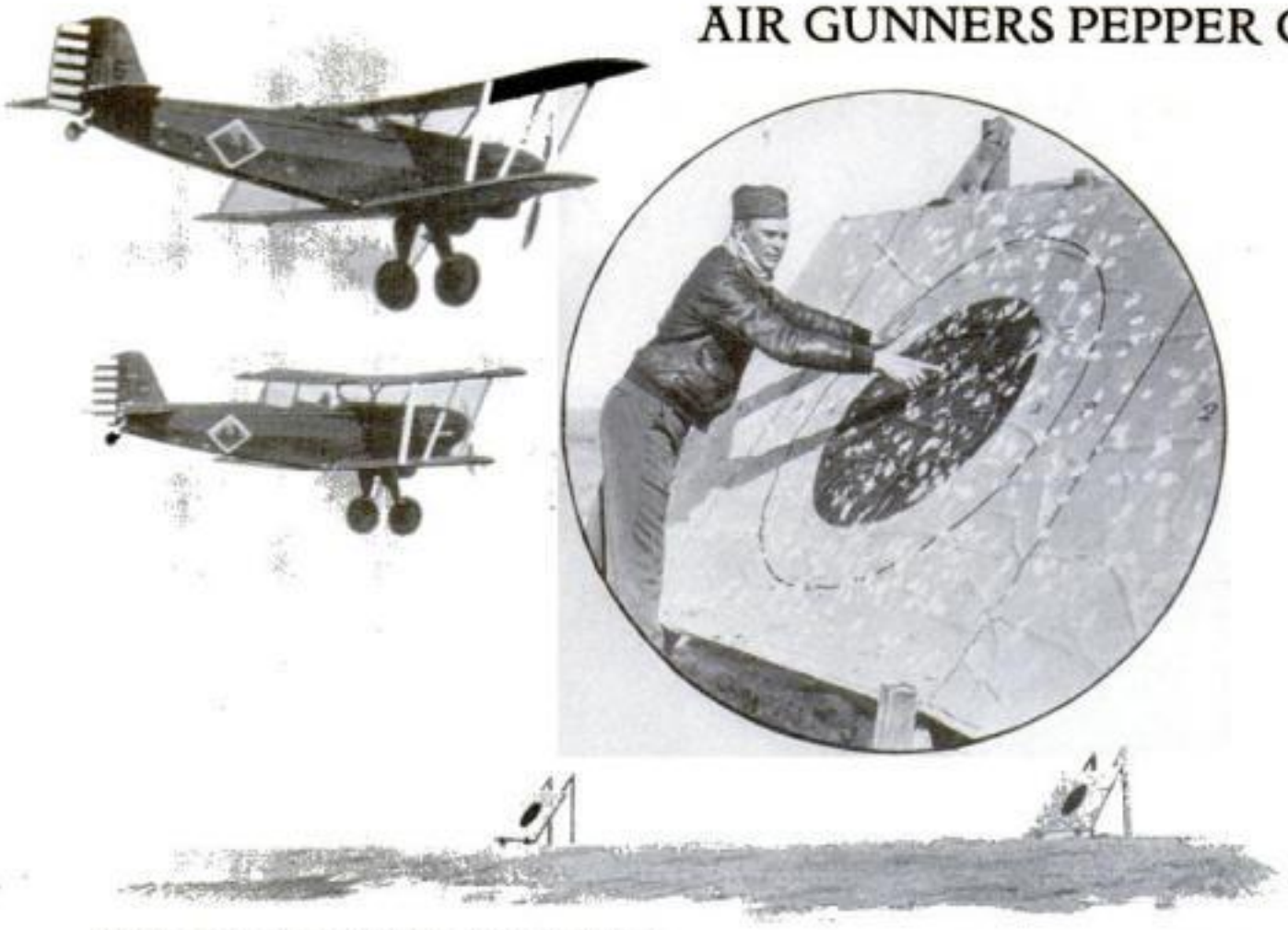
FOLLOWING successful tests in the North Sea, the steamer *Westfalen*, converted to a floating airdrome, has been ordered to its station in mid-Atlantic. It will serve as a halfway stop between Africa and Brazil on the world's first ocean airline, linking Berlin and Rio de Janeiro (P.S.M., Feb., '33, p. 13). Radio will guide planes to the *Westfalen;* in addition, the vessel will send up signal smoke columns by day and flash searchlights by night. The pilot lands in the water, taxis up on a drag sail of canvas trailing behind the ship, and is hoisted aboard by a crane. After refueling, the machine is launched by a monster catapult for the second leg of its journey. Trial flights are scheduled to start immediately.



This plane is taxiing up the canvas drag sail attached to the *Westfalen.* As it rises on the sail, a big crane seizes it, lifts it clear, and swings it to the runway which extends entire length of ship

The camera clicked at the instant the big plane was ready to be launched by the catapult, controls of which are shown at the right

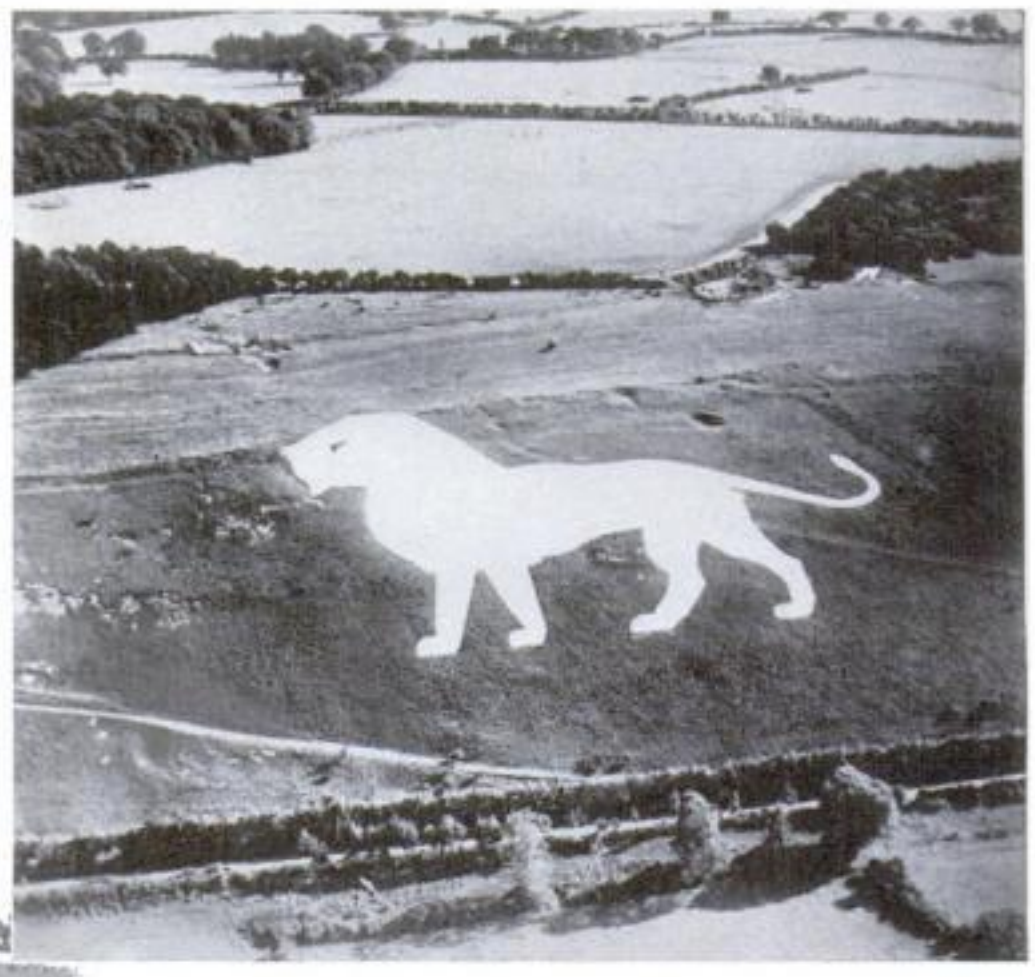
AIR GUNNERS PEPPER GROUND TARGET

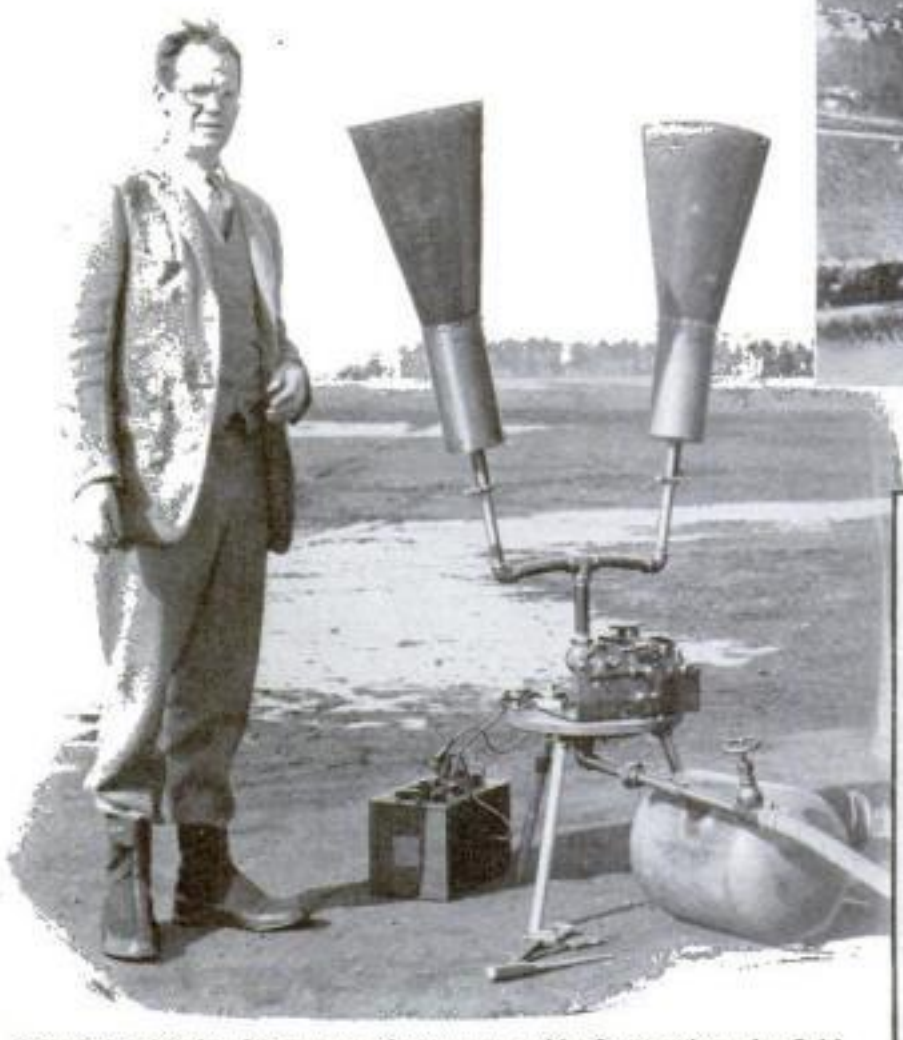


RAKING ground targets with machine-gun fire, members of the Ninety-First Observation Squadron recently ran up high scores at a new practice range near San Francisco, Calif. The paper targets, ten feet wide and six feet high, were propped up on adjustable mounts at an angle of sixty degrees. Diving on them in formation, the pilots riddled the black bullseyes with flying lead and tracer bullets. After each attack, a ground crew covered the bullet holes by pasting bits of paper over them so the targets could be used again without covering the framework with a completely new paper. The maneuvers were part of ground strafing practice, in which the planes dive and skim low over the ground with their machine guns blazing. In wartime, the maneuver is intended for use in an attack on trenches or supply trains or on infantry lines when on the march.

HUGE LION CUT IN CHALK WARNS FLYERS FROM ZOO

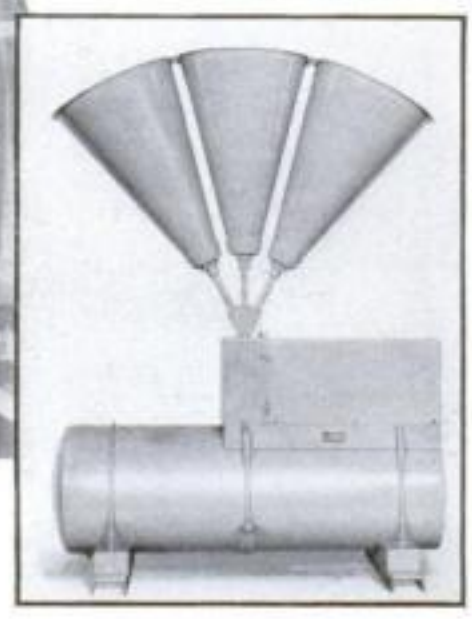
LATEST among oddities in ground signs to meet the eyes of airmen is a huge white lion of glistening chalk at Whipsnade, England. This figure was cut in the ground at the request of the Whipsnade zoo, where animals had been terrified by the roaring of motors of low-flying airplanes, and it effectively warns approaching pilots to keep their distance. The size of the sign may be judged by comparison with the trees in the foreground of the striking aerial photograph reproduced at the right. Situated about thirty miles outside of London, the white lion serves as a landmark to airplanes approaching the metropolis from the northwest, although its presence might pass undetected from nearby motor highways.



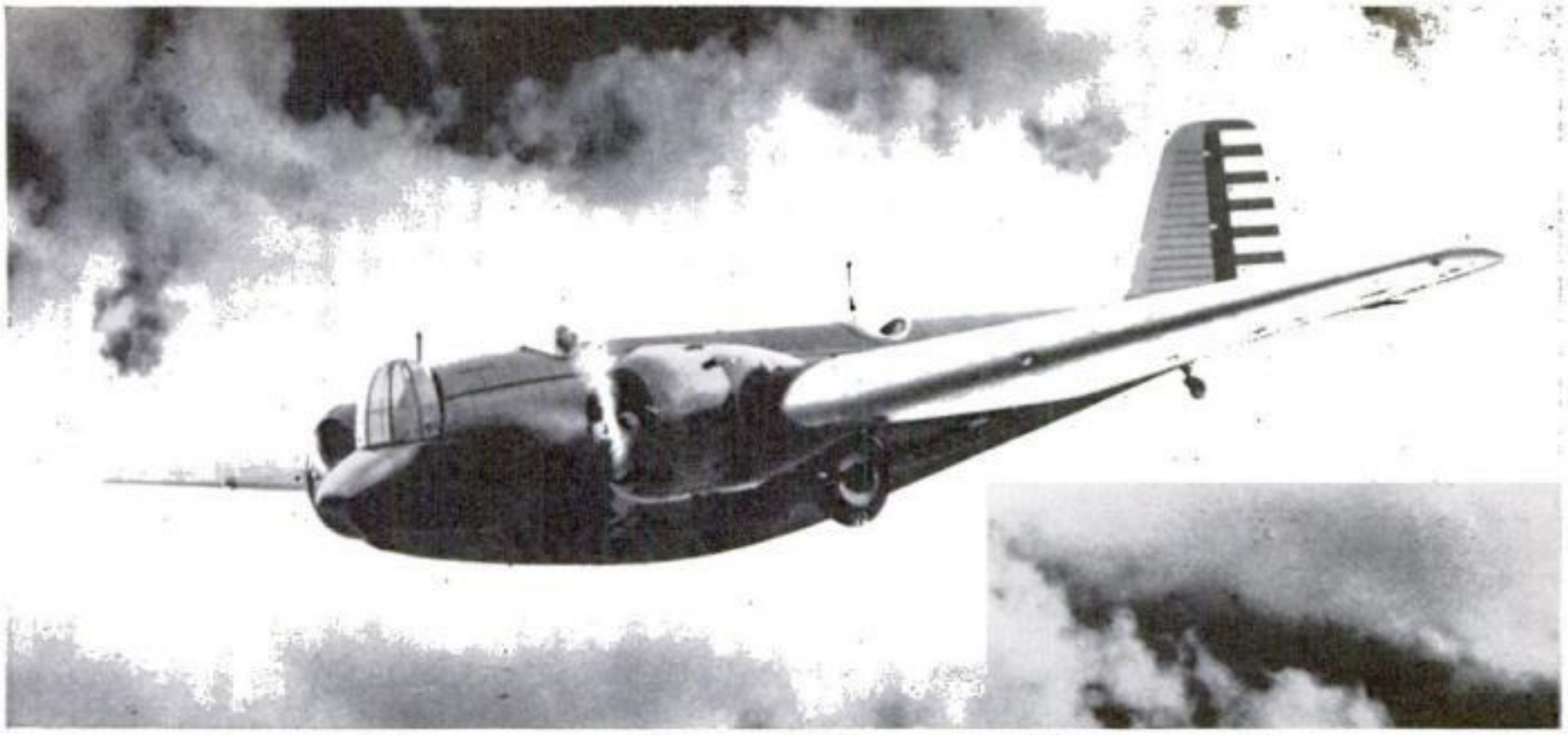


This fog whistle, for use at airports to guide flyers when the field is invisable, is operated by compressed air. Right, another type

FOG WHISTLE FOR AIRPORT



Fog whistles for airports may soon enable a pilot to land safely when weather conditions make it impossible to see the field. General Electric engineers announce the development of a new sonic marker beacon that emits a series of short, high-pitched whistle blasts from a cluster of two or three megaphones. One of these beacons would be installed at each end of the field, and the pair arranged so they would sound alternately. When an approaching pilot hears a continuous blast, he knows he is above the center of the field.

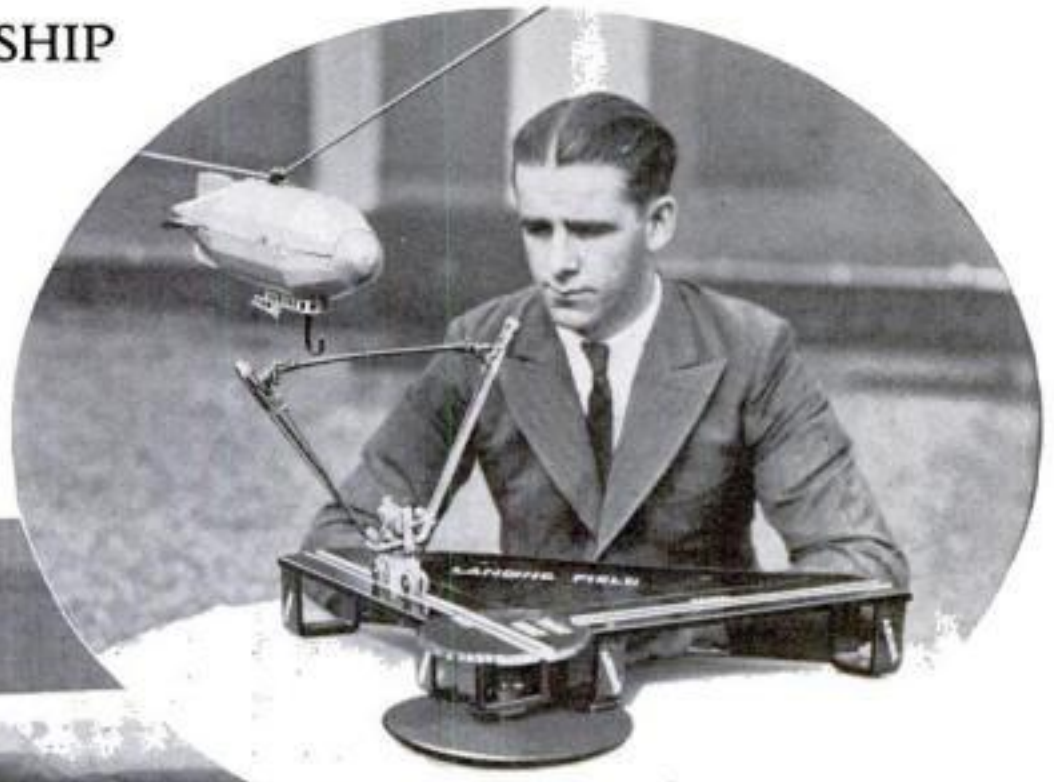


Army Bombing Plane Outflies Pursuit Ships

A NEW bombing plane, developed for the American Army, may alter present styles in aerial warfare. Hitherto tiny, one-man pursuit craft have been relied upon to overtake and attack enemy bombers. In practice flights they wheel and circle about the big bombing machines, which are slowed by heavy loads. One of the new Martin bombers, however, turned the tables on its pursuit ships by outdistancing them during a recent practice flight from Dayton, O., to Washington, D. C. Its pilot throttled down the two 550-horsepower motors on the wings, so the pilots of the other craft could keep up with him. While the speed of the new craft is an official secret, it is reported to exceed 200 miles an hour. Military observers foresee that a fleet of the new bombers could strike a telling blow in warfare, dashing away too fast for enemy pursuit craft to overtake them. The all-metal craft carries 2,000 pounds of bombs. A machine gunner at the forward end is protected from the air blast by a revolving, transparent turret. Landing wheels are drawn up in flight. The U. S. War Department has just placed an order for thirty-eight of the new machines. The photograph above shows one in flight.

MOORING MAST SNARES AIRSHIP

SNARING airships out of the air, to aid them in landing, is a scheme proposed by Richard Thorpe of Mays Landing, N. J. His system resembles that used by aircraft in picking up mail on the fly, worked in reverse. A mooring mast in two split sections suspends a flexible mooring member in the path of the oncoming dirigible, which is provided with a mooring ring. When the airship has maneuvered into the proper position, the mooring member snaps and locks upon the ring and the ship may then be hauled to earth. The mast, provided with tracks and turntable, may be faced into any wind.



Richard Thorpe demonstrating his model of a mooring mast with which to land big airships

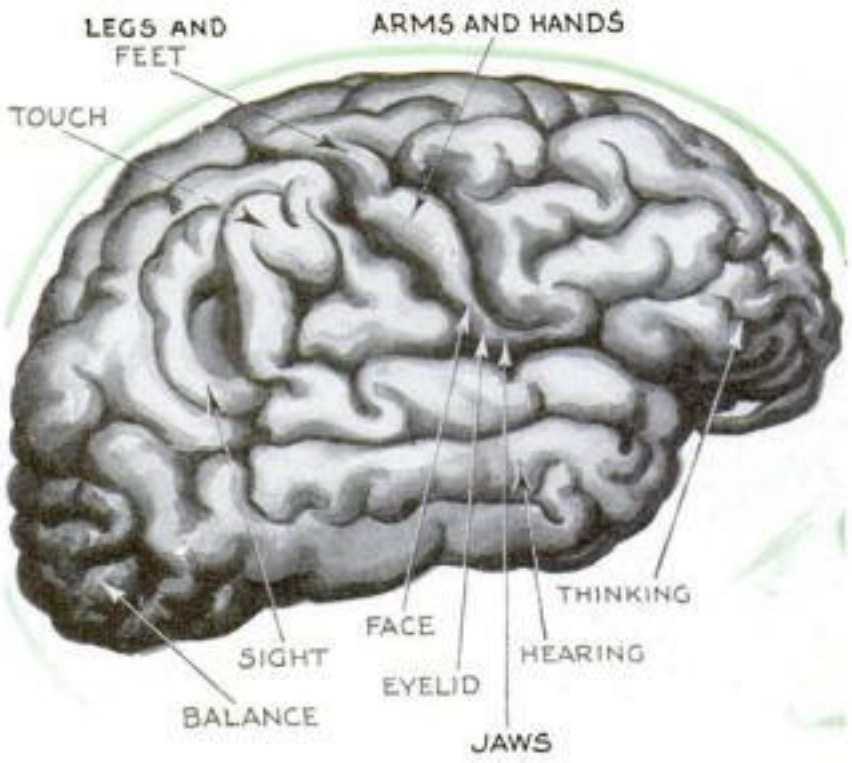
Into this motorless glider are being loaded 200 pounds of mail preparatory to carrying it without power from one city to another seventy-eight miles away

GLIDER CARRIES MAIL SEVENTY-EIGHT MILES

CARRYING air mail seventy-eight miles in a motorless glider was the record feat performed recently by Robert Kronfeld, German soaring champion. He took off from Vienna, Austria, in tow of an airplane that cut him loose at an altitude of 12,000 feet. Soaring to Semmering, Austria, he unloaded his 200 pounds of mail one hour and forty minutes after the start.

OPERATIONS ON Human Brain

mark a big advance in Modern Surgery



This drawing of a human brain shows the specialized functions controlled by the various sections. It is because these areas are known that surgeons are able to find a diseased spot inside the head. At right, diagram showing how you can draw two imaginary lines on your head to help you find the parts of your brain that govern mental activities

IF YOU were in an operating room watching surgeons working on the brain, you would see things that would make you gasp. For example, at the Cleveland, O., Clinic, August 31, 1931, Dr. W. James Gardner removed the entire right half of the brain. And the patient recovered!

A woman, thirty-one, mother of two small children, had suffered from epileptic fits for ten years. She was becoming blind and had terrific headaches. The pressure of a growing tumor inside her skull was killing her.

From the right side of her shaved head, Dr. Gardner removed a section of skull four and a half inches in diameter. Then he cut through the dura, the tough protecting membrane covering the gray matter. Under it, he saw a cauliflower-like growth covering the surface of the brain. It had eaten its way like a cancer throughout the entire right hemisphere. The left half of the brain, far more important than the right because it contains the centers for speech and writing and governs the right side of the body, was perfectly healthy.

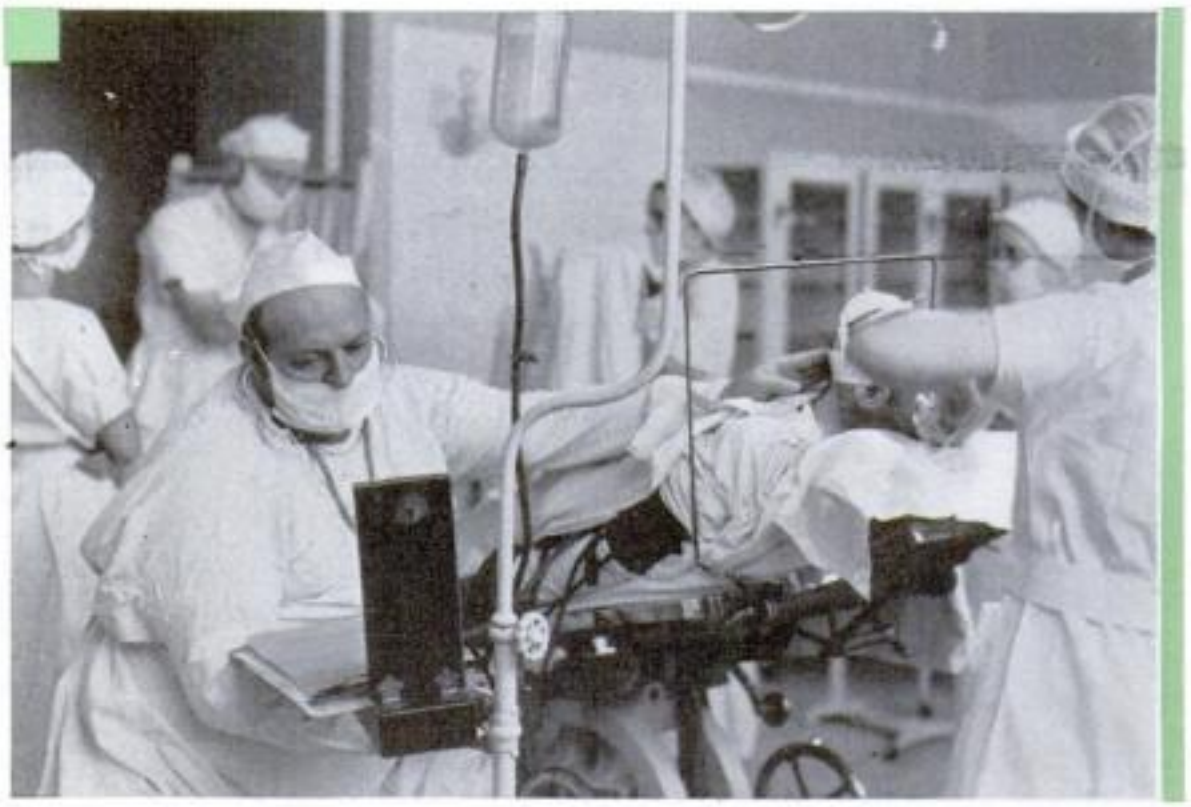
Four times before, Dr. Gardner knew, distinguished surgeons had removed the right hemisphere of a patient's brain and every time the results had been fatal. Yet, it was the woman's only chance. With deft hands, he slipped loops of catgut around the arteries and veins and pulled them taut. This stopped hemorrhage. Then he scooped the entire right half of the brain, containing the huge tumor, out of the skull!

The cavity was filled with warm salt solution, the plate of bone replaced and anchored with silk, the flap of scalp sewed back in place, and the operation was over.

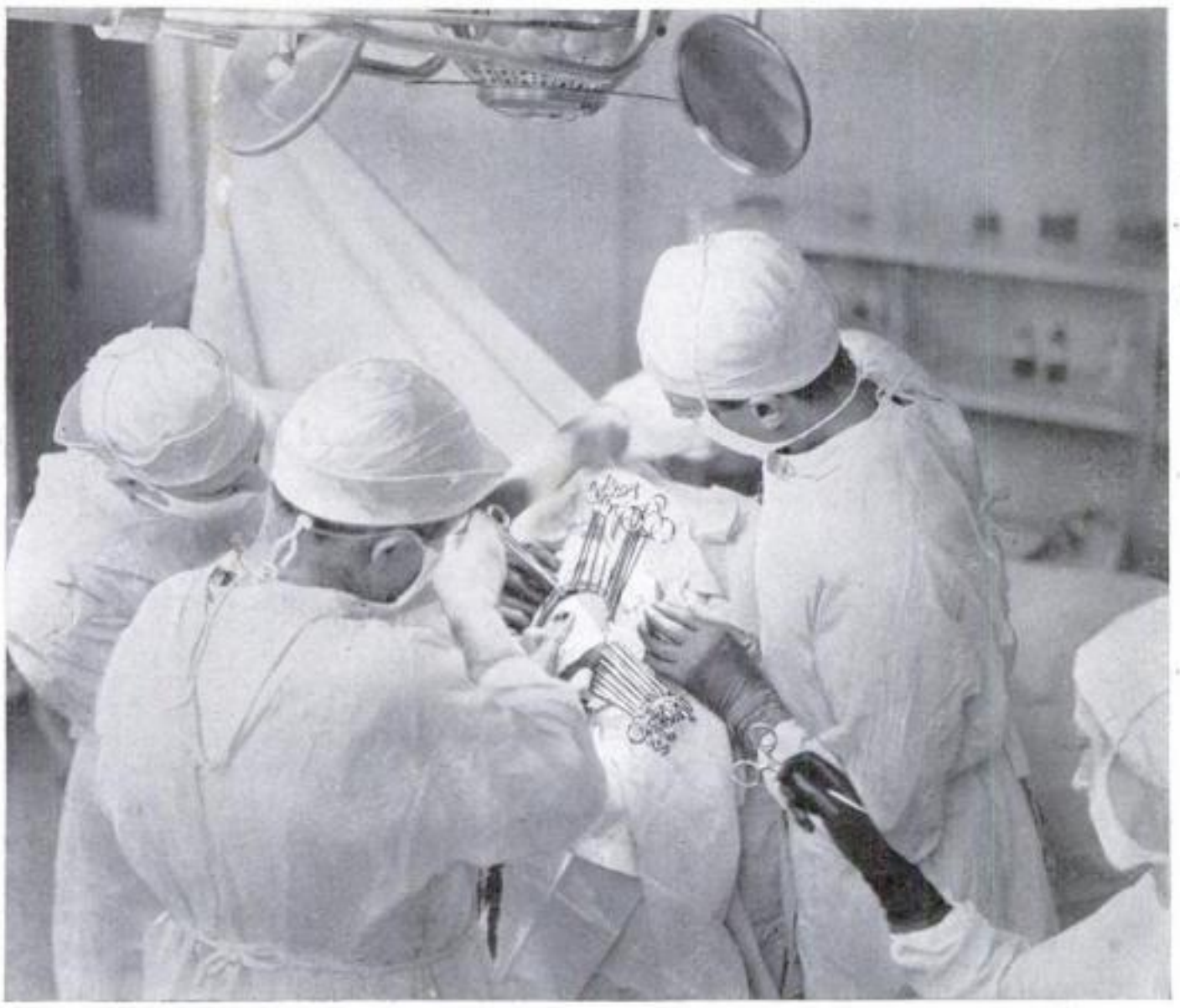
A few hours later, the woman recognized and talked with her friends. She improved rapidly, reading and writing during her convalescence. Her headaches and epileptic fits were gone. Although her left arm and leg were stiff, due to the loss of the right hemisphere of the brain, she was able to walk and three and a half months after the operation, she was helping care for her children.

One of the most amazing things about the human brain is its ability to recover from seemingly-fatal injuries.

I recall one case during the World War. A soldier was brought back from the lines, the front part of his brain riddled with shrapnel. We removed one piece, lodged deep between the two frontal lobes, which was two inches in diameter. The rest we did not dare touch because the fragments were too widely scattered. Nevertheless, the patient made an excellent recovery. He was not paralyzed in the least and his senses were unimpaired. The only troubles

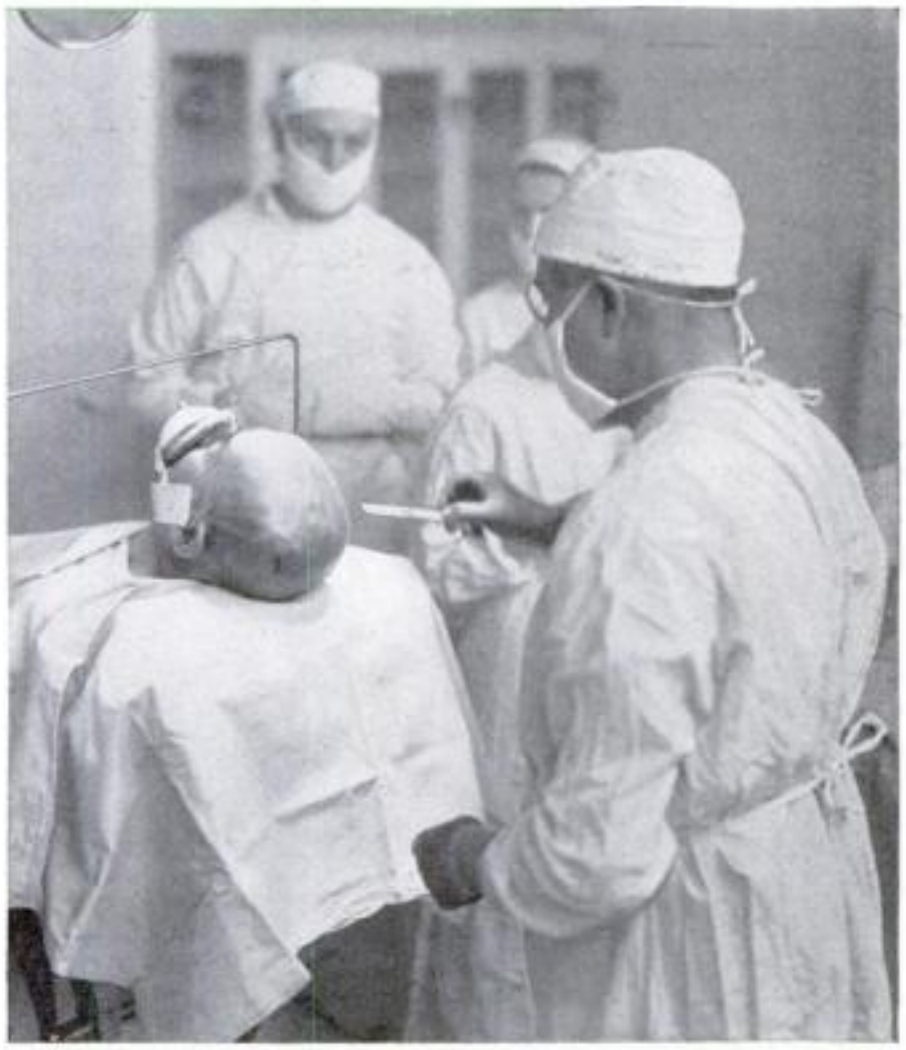


In preparation for a brain operation, the head of the patient is first shaved. In left foreground, is the anesthetist who is watching the instruments that record the blood pressure



By
FREDERIC
DAMRAU,
M. D.

The Remarkable Pictures Illustrating This Article Were Taken by Our Photographer During an Actual Brain Operation



At this point in the operation, the incision in the scalp has been made and clips are being put in place to hold the edges of the severed scalp away from the exposed skull. At right, the surgeon is holding his knife ready to cut through the scalp of the patient who is unconscious

that remained with him were slowness of speech and a tendency to forget appointments.

On the Fourth of July, three years ago, an eighteen year old boy in Fargo, N. D., placed two lighted firecrackers in the barrel of a tire pump. They exploded with such force that they blew the handle off the pump and drove the piston shaft, a steel rod five-sixteenths of an inch in diameter and eighteen inches long, through the boy's skull and brain. It entered near the right eye and projected from the back of the skull.

Dr. Joel C. Swanson treated the boy for shock, gave him antitoxin against lockjaw and sterilized the protruding ends of the shaft with iodine. Then he pulled the shaft out. The boy recovered and successfully completed another year of high school. Apparently, his mind did not suffer from the accident.

On record in one European hospital is the astonishing case of a shoemaker who, during a temporary fit of insanity, tried to commit suicide by driving nails into his head. When he was brought to the hospital, five two-inch nails penetrated through the bone of the skull into the brain. Yet, after a surgeon removed the nails, the man recovered and he was later discharged completely cured.

Most incredible of all, is the story of the New England laborer who lived for twenty years after an iron bar, an inch thick, had been driven by an explosion through his skull and brain. The bar entered just below the left cheekbone, destroying the left eye, and a large part of the brain, and coming out at the top of the skull. Not only did the victim of this accident make a miraculous recovery, but he continued to perform his duties as a farm-hand and coachman to the entire satisfaction of his employers.

Such accidents to the brain have played a part in enlarging the surgeon's knowledge of this vital organ. Step by step, medical men have built up a mass of information about it by observation of the sick, study of the brain after death in hopeless cases, and by stimulating the brains of dogs and monkeys with an electric current.

During the Franco-Prussian War, two German physicians, Gustav Fritsch and Eduard Hitzig, stimulated the brains of wounded soldiers and for the first time produced definite movements in unconscious humans by means of an electric current. Applying the electrodes to one spot, they made the legs move; to an-

Surgeon cutting a piece of celluloid to the desired shape to replace bone from skull of patient shown on page 25

other, the face; and to another, the fingers. Thanks to experiments on dogs and chimpanzees, the surgeon now knows exactly which part of the brain controls each function of the body. According to the symptoms, he knows just what part of the brain is diseased and where to operate. In the field of brain surgery, there can be no guessing.

There is a simple rule by which you can map out, on the outside of your skull, the location of the motor area that controls all the movements on the opposite side of your body. Draw an imaginary line from the root of your nose over the top of your skull to the bump on the back of your head. From a point half an inch behind the middle of this line, draw another line, three and three-quarters inches long, extending downward and forward at an angle of seventy degrees. In front of this line is the control-room governing bodily movements, the motor area of the brain in control of all your movements.

BEHIND the line is the portion of the brain that governs all the sensations to which the body is exposed. The only nerves connected directly with the hemispheres of the human brain are those controlling the sense of smell. Originally, our brains were smelling organs.

Just behind your forehead, are the frontal lobes with which you do your thinking. Savages and idiots have low, receding foreheads because this part of their brains has not developed. Strange to say, when one of these frontal lobes is destroyed by an abscess or a tumor, some other part of the brain tries to take over its functions and do the thinking.

Many geniuses have willed their brains to medical science for careful study under the microscope. Examination of the brain of Anatole France, the famous French writer, revealed that the convolutions and gray matter cells were both of exceptional development. When Nikolai Lenin, founder of the Russian Soviet Republic, died, his brain was sliced into 31,000 specimens and studied carefully by many scientists. Turgueneff, the Russian novelist, had one of the largest brains on record. It weighed more than four pounds. However, the size of the head is not an accurate measure of intelligence, for one of the two brains that exceeded his in weight was that of an imbecile. Large brains have no more units than small ones but the units are larger.

In the back part of the brain is located the center of sight. A tumor or injury here causes blindness. The lobe of the brain near the ear governs hearing. Just in front of the lower part of the motor area is the voice center. On the flat surfaces where the two hemispheres almost come together are the centers of smell and taste. We hear words with one part of the brain; see words with another part, and speak words with a third.

STRANGE things occur when any of these centers are disturbed. In one instance, a professor who used Latin and Greek fluently was struck on the head in an accident. When he recovered, he had forgotten every word of these languages. The cells of the brain in which they were stored had been permanently injured by the blow while the rest of the gray matter remained normal.

In another case, a little artery that supplies blood to a small area in the visual region of a patient's brain became plugged. Overnight she became as illiterate as an Australian Bushman. She could see perfectly but she could not read a word. She had been struck by word-blindness, a rare brain affliction which prevents the recognition of words when seen in type. Similarly, when another center of the brain is injured word-deafness results. Hearing is acute, but spoken words mean nothing. In one small patch of gray matter, hardly larger than a nickel, is stored every word we know!

A few weeks ago, medical authorities were amazed by a report coming from Los Angeles, Calif. A twenty-year-old Mexican girl, day after day ran a temperature of 110 degrees. One hundred and seven degrees had been considered fatal. The Medical Director of the Los Angeles General Hospital reported that for more than a month the girl lived with a temperature higher than that of any other known sufferer. Specialists who examined the patient concluded that a tubercular tumor in the heat control center of the brain had upset its normal operation in regulating the temperature of the body.

Because a surgeon can lay out a map on the skull of a patient and know that under each section lie the cells controlling a special function of the body, he can know the exact position of any trouble. New methods of diagnosis, such as injecting air into the brain cavity, have also increased the accuracy with which the surgeon can trace the effect back to its cause.

I REMEMBER one man who was cured of epilepsy by the removal of a brain tumor that we found in this manner before an operation. Since convulsions invariably started in his face, we knew that the trouble was in the motor area, near the lower third of the previously-described imaginary line, running from the nose to the back of the head. To determine its size and position, we drilled two small holes through the skull near the bump at the back. Hollow needles, pushed through the brain substance into its central cavity, drained off some of the fluid. Finally, air was injected into the cavity and X-ray pictures taken. They showed that the cavity inside the brain was entirely out of shape on one side, due to the pressure of an extensive brain tumor. With this knowledge at our command, we were able to remove the growth successfully in a single operation.

In New York, the famous brain specialist, Dr. K. Winfield Ney, with whom I worked during the World War, has recently developed a spectacular new technique for curing epilepsy, which he has demonstrated to be caused by the sagging of the brain after it has become attached in places to the top of the skull. The fits, in such cases, are caused by pulling upon the attached portion of the brain. Dr. Ney's *(Continued on page 102)*

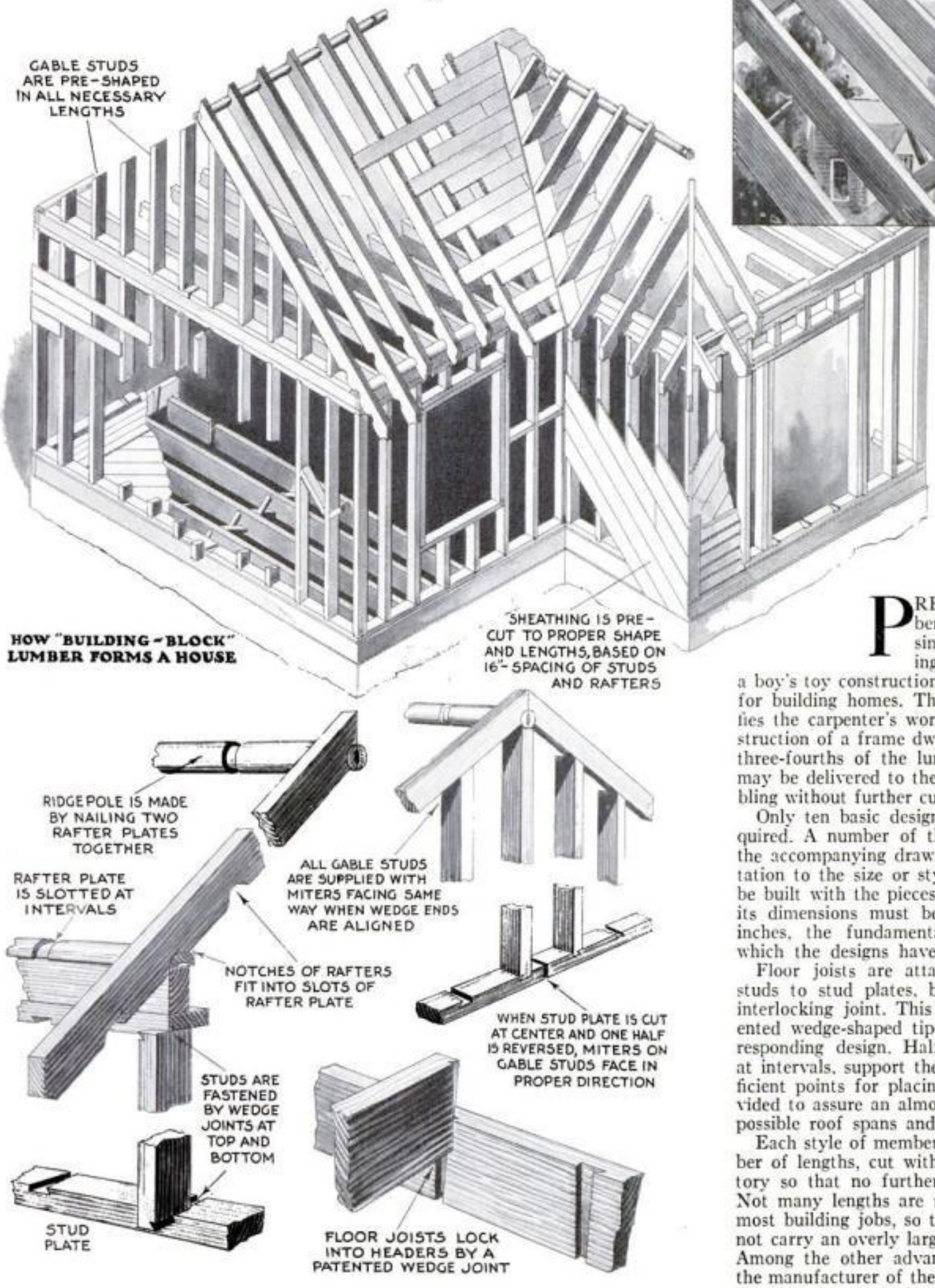
Below is an X-ray picture, taken recently, of the head of a man who was stabbed thirty years ago and in whose head the blade remains. It cannot be removed

Sensational cures are now effected by strange, new operations upon human glands. Next month, Dr. Damrau will tell the exciting story of this dramatic work

New, Shaped Lumber Comes Ready to Nail

ASSEMBLING THE ROOF

Ten Designs in Material Provide Wide Range in Size and Style for Frame Houses



HOW "BUILDING-BLOCK" LUMBER FORMS A HOUSE

HOME RISES QUICKLY WITH THIS MATERIAL

Illustrations show the form in which the lumber for homes is sold to builder and how it can easily be assembled in raising a dwelling. Note the notches and wedge-shaped joints that speed the job of putting the pieces together readily and with little chance for making a mistake

PRE-CUT pieces of lumber that fit together as simply as the interlocking blocks and strips of a boy's toy construction set are now available for building homes. The new method simplifies the carpenter's work and speeds the construction of a frame dwelling, since more than three-fourths of the lumber used in a house may be delivered to the site ready for assembling without further cutting.

Only ten basic designs of members are required. A number of these are illustrated in the accompanying drawings. There is no limitation to the size or style of house that may be built with the pieces, beyond the fact that its dimensions must be multiples of sixteen inches, the fundamental unit of size upon which the designs have been chosen.

Floor joists are attached to headers, and studs to stud plates, by means of a strong interlocking joint. This is provided by a patented wedge-shaped tip and a socket of corresponding design. Half-round strips, slotted at intervals, support the notched rafters. Sufficient points for placing the rafters are provided to assure an almost limitless number of possible roof spans and pitches.

Each style of member is supplied in a number of lengths, cut with precision at the factory so that no further carpentry is needed. Not many lengths are required, however, for most building jobs, so the lumber dealer need not carry an overly large assortment in stock. Among the other advantages pointed out by the manufacturer of the "building-block" lumber are that it is impossible to install any piece in the wrong place, dispensing with the need of numbering and sorting pieces, and that the standardization of pieces simplifies the figuring of the job and eliminates mistakes in ordering the lumber.

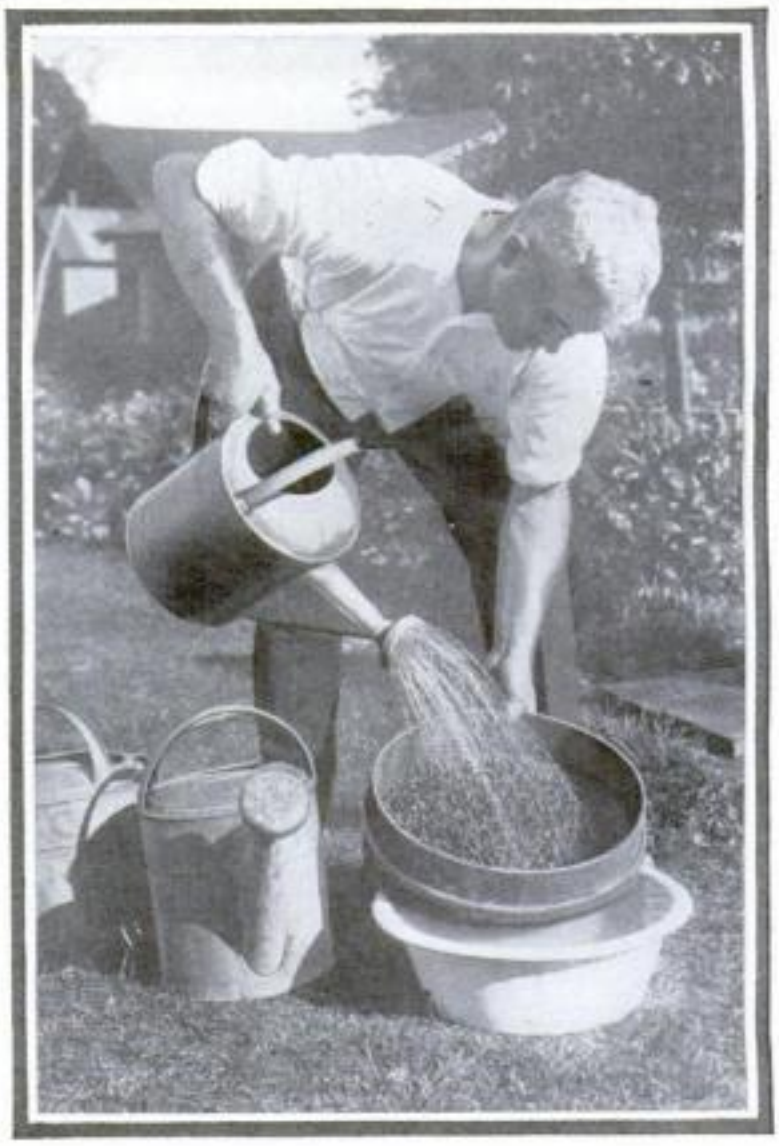
GROWING Garden Seeds Now Giant Industry

When the petals of the aster have all withered, leaving only the dried seed pod, the seeds are gathered. The grower crushes pod with his hands and then drops it in the tray

Seeds of the coxcomb are found beneath the flower and drop off when the plant is shaken. In the case of the dahlia, at top, the seeds are in the center of the flower. At left, the Japanese Lantern must be torn apart in order to get access to its seeds

Seeds are fanned free of hulls and chaff and then they are flushed with water, as is being demonstrated below by Joseph W. Bedman, well known seed grower. Cleaning seeds in this way is the first step in their treatment after being gathered

To get the seeds of a squash, it is left on the ground until it withers. Then it is opened and the seeds collected. At top, taking out seeds through a hole in a pumpkin. At right, watermelons are split and dropped in keg where they ferment so seeds sink



In order to protect seeds from parasites, formaldehyde and other chemicals are sprayed on them as is shown in photo

Corn is left to dry still attached to the husk and stalk. When thoroughly dry it is shelled, tested, and selected kernels only are retained for seed

Seeds stored in bags are apt to become infested with bugs and so occasionally they are placed in a vault and fumigated with carbon disulphide fumes. Vapor is released by container here being filled with liquid

This vacuum cleaning machine sucks the heavy dirt into the bag at left, chaff into center bag, and delivers seeds into basket

This elaborate machine at the Peter Henderson seed plant discards the shriveled and worthless seeds. Photo shows peas pouring into the trough, whence they pass into the triangle-shaped sections where they are vigorously shaken, forcing the light seeds out at the back

WHEN you consult the spring catalogs and lay in a supply of seeds for your garden, do you ever wonder how they got in the packets? On these pages the POPULAR SCIENCE MONTHLY photographer takes you behind the scenes in the seedman's nursery, where experts labor to make sure the seeds you buy will yield fine flowers or vegetables. Collected in trays, the ripe seeds are washed in screen-bottomed containers. Spraying or fumigation destroys parasites that attack the larger types. Sorting, vacuum-cleaning, and weighing machines handle seeds sold in bulk. To fill flower seed packets, like those above, girls use oddly-notched wooden spoons. Large growers raise many of their own seeds, purchasing the balance from individual raisers. The search for the best varieties extends to far corners of the globe.

Last step of all is filling the seed packages as you buy them at the store. Here flower seeds are being placed in paper containers. Notched wooden spoons, holding definite number of seeds, are used

No Job Too Tough for

Emergency Division of Police Tragedies and Freak Accidents

Members of the Police Emergency Squad are armed with automatic rifles like the one shown here. They are used in subduing criminals or stopping a riotous mob

To be sure their gas masks will be effective protection in an emergency, members of the new police unit test the masks by going boldly into a heavy cloud of gas

Crews of the Emergency Division of the police force answer alarms in trucks like the one seen at left

By Thomas M. Johnson

A NEW building was going up. Before it stood a big concrete mixer. To chew up stone, gravel, and sand, its vat-like interior had strong teeth, powerful flanges, and cogwheels. To keep these fed, was the job of one man who stood on a running-board and watched those teeth grind concrete.

Suddenly the man slipped. Frantically, vainly clutching for safety, he toppled into the mixer's jaws. Bruised, half-smothered in liquid concrete, he was shocked by violent pain. His leg had been caught in the cogs. Those crunching teeth were tearing flesh and breaking bones. His screams of pain and terror brought men on the run.

Barely in time, they stopped the mixer. It had ground up its victim's leg, nearly to the hip, and still held it in a cruel grip. Pain-tortured, he lay, half submerged in the concrete, whose gray was stained red by his blood. Before he bled to death, he must be got out. The gathering crowd milled about, crying, "Get a doctor!" A policeman ran to a telephone and put in an emergency call.

Two minutes later, a screaming siren announced the coming of a dark green truck trimmed with twinkling brass. From it leaped young policemen, who dashed for the machine that had trapped a man. The sergeant sized up the situation.

"If we move those wheels," he said, "we'll kill him."

Quickly the men in blue brought a stretcher, blankets, oxygen tank, and an acetylene torch. While some of them tended the injured man, others using the acetylene torch, skillfully and swiftly burned away the heavy steel cogwheels. Gently they lifted the victim out and into a waiting ambulance. He would lose a leg, but he would live—thanks to the green truck.

In a few hours the green truck rolled again. This time through dark streets to a loft building. There stood a patrolman.

"C'mon," he urged. "Here he is!"

He turned his flashlight into an open coal-chute. It shone upon a glistening bald head, entirely surrounded by coal. A plaintive voice implored:

"Get me outa here!"

"Is that your burglar?" the Sergeant asked.

"Sure," replied the patrolman. "Tried to get in through the coal chute, and got stuck. That's an emergency, so I sent for an Emergency Squad. Right?"

From the green truck were produced sledge-hammers, crowbars, saws, chisels, wrenches, and shovels with which they dug out the burglar.

To meet situations as widely different as these two, the green trucks carry, all told, 103 different pieces of equipment—and their crews are trained to use them. This Emergency Service Division is the most versatile and adventurous branch of the whole New York Police Department. Its green trucks don't roll unless the rest of the Department is more or less stumped—whether by a hazardous rescue, a riot, an explosion, a gas suicide, or one of New York's myriad freak occurrences, as for instance, horned owls. They were keeping people awake nights in peaceful Flushing, Long Island, part of the Greater City. So a green truck went, with portable searchlights and shotguns—and the owls hooted no more.

To meet any crisis, big or small, the Emergency Service Division has called to its aid science and invention. Inspec-

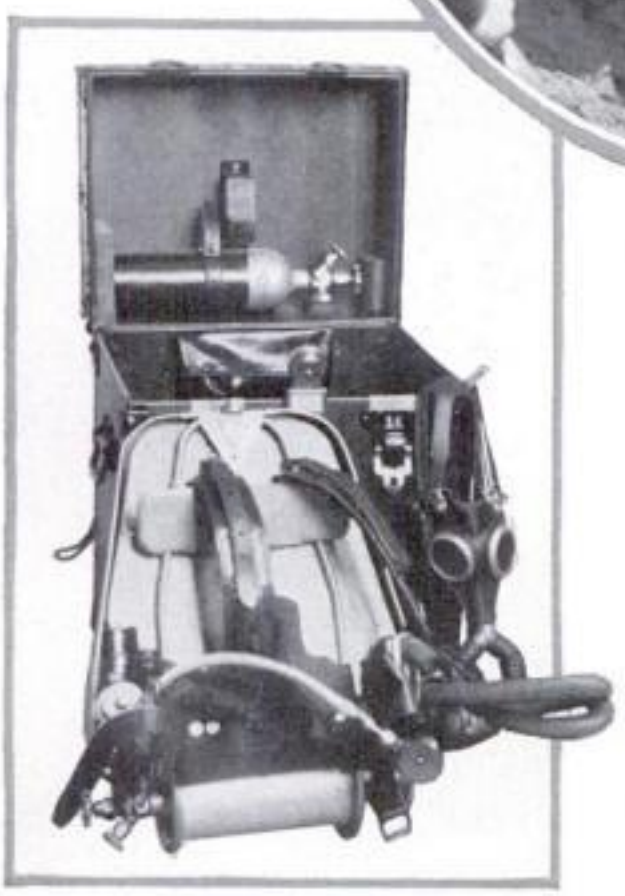
Minute-Men Cops

Trained to Handle of a Great City

This strange looking figure is a policeman wearing full gas equipment, including the breathing apparatus. Recent tests have shown this outfit may be used as diver's suit in recovering drowned bodies

After a drowning man is taken from the water, this inhaler is used by the Emergency police in an effort to revive the unconscious victim

When cave-ins bury workmen, it falls to the Emergency Squad to rescue them as is being done in the accident shown above



The full McCaa breathing apparatus that is worn by the police in a gas filled room

tor D. A. Kerr and Deputy Inspector Louis F. Dittmann welcome new ideas and better methods. The present Division of 512 men, manning twenty trucks so distributed that in three or four minutes one can reach any point in the city, is New York's newest police unit. It has saved an estimated $10,000,000 to the city, and its usefulness increases. In 1931 green trucks rolled 3,928 times, in 1932, between 5,000 and 6.000 times—a thirty per cent increase. Other American cities are adopting the idea, and the British Government has made specific inquiry about its anti-gas measures.

New York does not dread gas air raids in the next war as does London, but the emergency squads are trained to wage chemical warfare. At their headquarters in the Police Academy building, they have laboratories and gas chambers where they experiment constantly in an effort to find new means to save human beings from death by any gas —natural, fumigant, carbon monoxide. For every gas suicide, a green truck rolls; and its trained men have worked thirty-five hours to save a life some one had thought worthless. Seven policemen once saved a baby by breathing into its mouth incessantly for two hours. Suicides increased in depressed 1932, but not gas suicides.

That is a phase of the defensive work of the squads, which makes them an effective "save-a-life league." But there is a grim offensive side to their operations.

One of the most amazing events in modern crime annals, was the seige of "Two-Gun" Crowley a couple of years ago. This notorious criminal and cop-killer was run to earth in an apartment house off upper Broadway. There, with a man and woman to help him, he stood siege, sniping at the police who were firing from the street and nearby housetops. A crowd of thousands gathered. Every police official from Commissioner Mulrooney down, was present. But it seemed impossible to make the capture—until the green trucks turned the trick.

Their crews came running, with light machine-guns that every truck carries. Working up as close as possible, they unloosed a crashing, ripping fire, that kept the desperados cowering on the floor. Then down upon them hurtled gas grenades that exploded, filling the small rooms with choking tear-gas. Snatched from the green trucks, dropped through holes in the roof chopped by axes from the same trucks, the grenades turned the tide. Blinded, weeping, "Two-Gun" and his mates came out, hands up.

Against another gas, the squads have

When the Emergency police are called upon to make a rescue from a high place, this life belt insures the safety of the officer

Emergency trucks respond instantly when a riot call comes in. Armed with tear gas and machine guns, the crews suppress hostile gatherings even when the mob greatly outnumbers them as shown in photo

made a counter-offensive to defeat its menace to life and health. This is hydrocyanic, or prussic, acid gas. Colorado uses it to execute murderers. New York warehouses and other establishments began to use it as a fumigant.

"Come quick!" pleaded a frightened telephone call. "Everybody here is dying!"

The crew of a green truck found a restaurant in which men, women, and children lay in a stupor with faces and bodies convulsed. A strange odor filled the room. Before they had got everyone out, policemen were strangling. In vain they sought throughout the restaurant for the source of the gas. Then someone went to the warehouse and stooped to the keyhole. He staggered back, clutching nose and throat. He had found the source of the gas. The warehouse manager, deciding to fumigate, had turned on the gas, locked the door, and gone home. The fumes had seeped through to the restaurant and nearly killed everyone there.

Thus the emergency squad had its first experience with hydrocyanic acid gas. Into a chamber filled with it, walked Inspector Dittmann, unmasked, to test human powers of endurance. Presently followed protective devices, a prescribed treatment, then a general order that anyone insisting on using the deadly stuff must notify the emergency squad and get a permit.

From this defensive chemical warfare has come a discovery that may develop into a new means to save lives from drowning. The emergency squad first adopted the McCaa Breathing Apparatus and a suit of gas-proof clothing as special equipment for policemen going into gas-filled rooms or buildings.

Early last summer those visiting one of the city baths, marveled to behold policemen clad in these gnome-like outfits, disporting themselves under water. On August came an opportunity for a real but sad test of the equipment. The twelve-year-old son of a New York policeman, attending a summer camp at Delaware Water Gap, Pa., had gone swimming and drowned. The body could not be recovered. Patrolmen Kiernan and Wynn, with Inspector Dittmann, took one of the gas outfits to the scene. Moored to shore by a rope, Kiernan walked into the river. An hour spent under water, with short rest intervals, and he had found the body. As a result, the Red Cross, Boy Scouts, and other organizations are now experimenting with the same suit, and the Navy is testing it as a new safety device for pilots of amphibian planes.

Already the rubber suits have proved their worth in a hazardous rescue along the marshy shore of Barren Island in Jamaica Bay. On a raw autumn evening, squatters there heard a cry for help. Rowing toward the sound, they saw across the water the head and shoulders of a young man, barely above the mire. Frantically, he cried to them:

"Help! Help! I'm sinking!"

"Hunting reed-birds," they told one another. "Caught in a quagmire. And we can't get to him. The reeds are too thick!"

One boatman raced for shore and a telephone. Down to the water's edge came the truck of Squad Fourteen. Out tumbled Patrolmen Padrick, Van Thunen, and Janosy. Hurriedly they donned rubber suits and, taking a 100 foot line, waded out into the reeds. Daring the treacherous slough that had nearly entombed the man they wanted to save, the policemen forged their way toward him.

When they at last reached their man, the quagmire had dragged him down until water was lapping his throat. To keep it from running into his mouth, he had to tilt his head back as far as possible. Drowning by inches was about to complete the work of fright and cold. The three policemen barely managed to drag him from his living grave with the long rope from the truck. When that fortunate youth, Edward Foley, 16, reached the hospital, he was blue from head to foot, but he was soon out again, hunting reed-birds.

Such experiences are continually adding to the knowledge of humanitarian police work collected by the expert trouble-shooting jacks-of-all-trades who ride the green trucks. Chosen for previous mechanical knowledge, they get postgraduate training to prepare them to face the emergencies of a city of six millions. They are taught metal-burning with the acetylene torch, handling block and fall, shoring, knots, grappling for bodies, gas masks and gases, breaking locks, boiler explosions, elevator emergencies, accidents and suicides on subway or elevated railways, handling mobs and riots. Varied as is their work, most spectacular is that of extricating men and women from the traps the great city sets for them.

To a Brooklyn Hospital was brought a man whom only an immediate operation might save. They put him on the table. Assistants and nurses stood by, as the surgeon bent over, knife in hand. Then the lights went out.

Candle-light would not do.

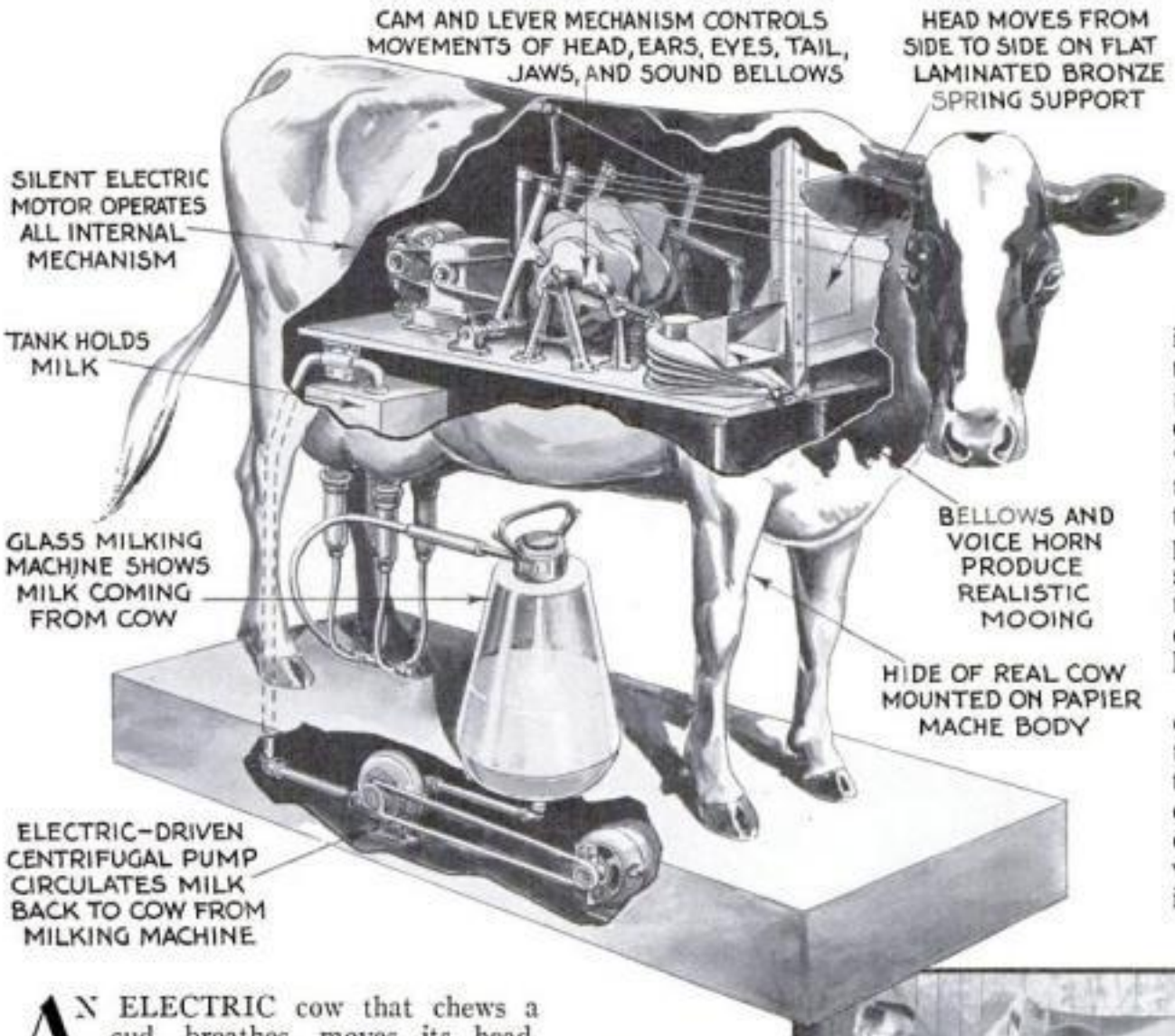
A moment's anguished silence. Then a stern command, "Call the police!"

A green truck rolled up to the hospital door. A few moments, and the operation was proceeding under light bright as day, furnished by the same portable searchlights that had revealed the horned owls.

On another night, these searchlights shone upon a heap of twisted ruins. A two-story factory had collapsed. Beneath tons of *(Continued on page 99)*

If it is necessary, in making a rescue from a high point on a skyscraper, this gun is used by the Emergency police to shoot a rope over the building

Robot Cow Moos *and* Gives Milk



Hidden Motors Give Exhibit for World's Fair the Movements of a Living Animal

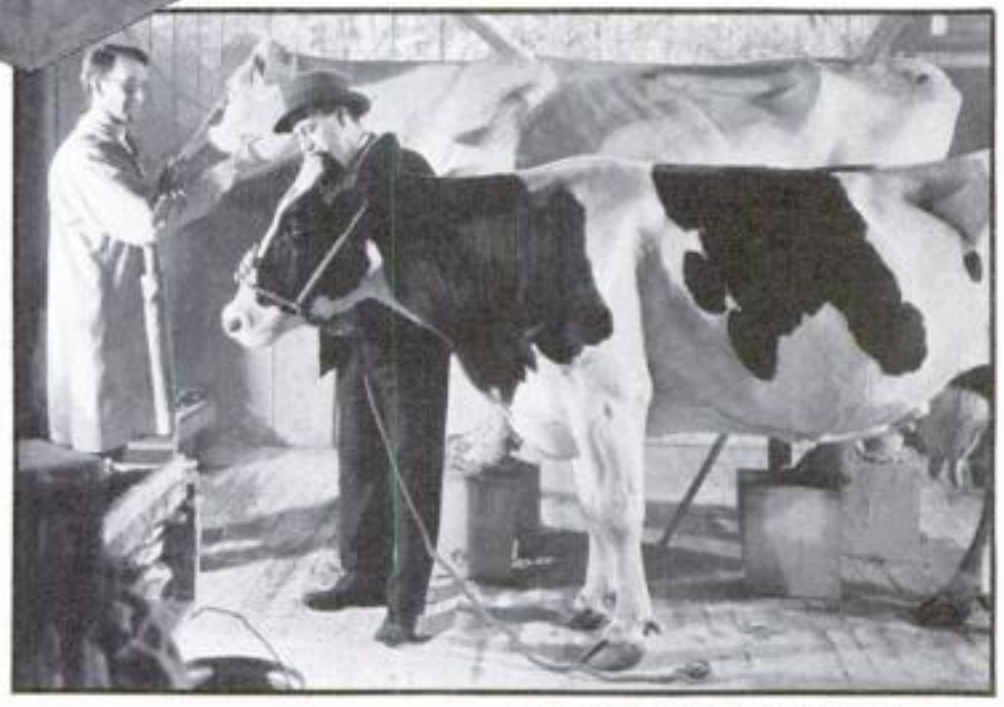
in the cow operates cams and levers to produce the various lifelike movements is illustrated by our artist's drawing. The different-shaped cams vary the speed of the movements of the tail, jaws, head, ears, and eyes to make them more realistic. Forming the support of the head is a flat flexible bronze spring that bends from side to side as the head moves. The sides of the mechanical cow move in and out in regular rhythm to simulate breathing.

A glass milking machine milks the cow, real milk coming from a tank in the udder. Spectators see it drawn through transparent tubes into the glass container. But they do not see a small centrifugal pump, in the pedestal upon which the animal stands, which pumps it back again. The cow cost $3,000.

AN ELECTRIC cow that chews a cud, breathes, moves its head, winks its eyes, moos, and gives real milk will form one of the exhibits at the World's Fair next summer.

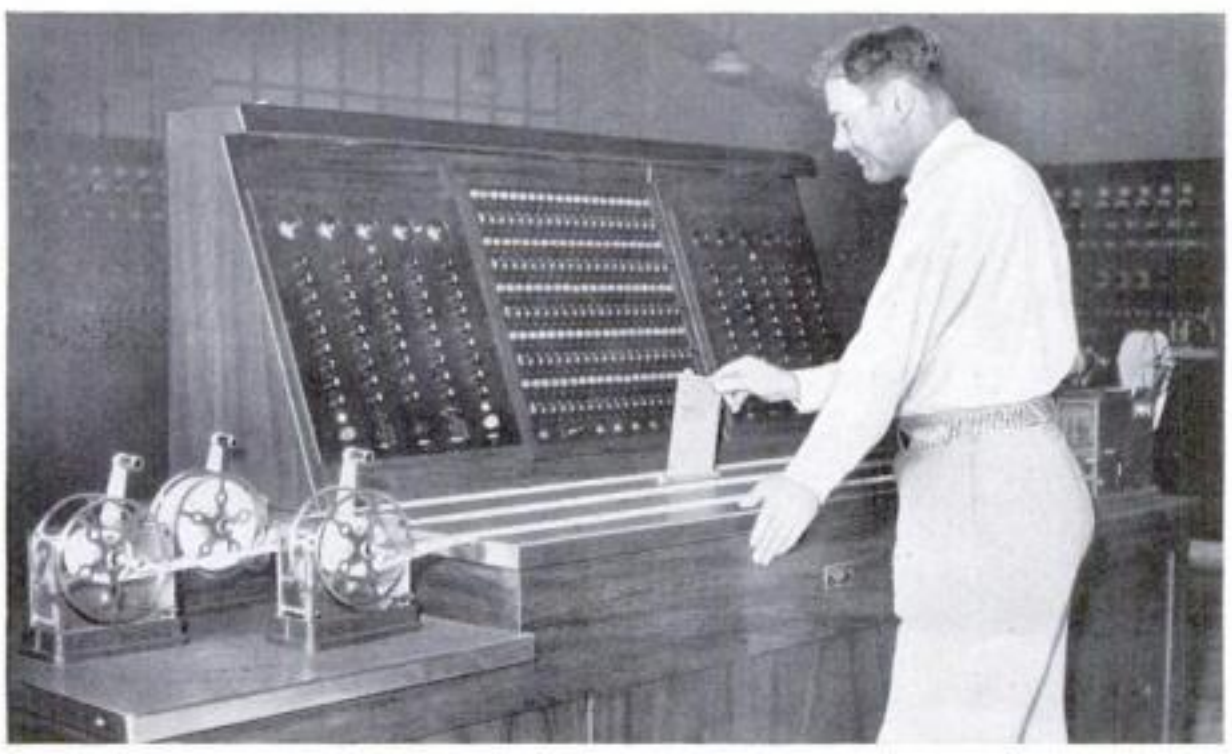
This robot animal has just been completed at the New York City workshop of Messmore and Damon, specialists in creating mechanical beasts that range from prehistoric dinosaurs to modern puppies. It is an exact reproduction of a Holstein milk cow, the hide which covers the papier-mache body being that of the real animal. This particular Holstein was chosen as a model because it had a large black spot on one side. In the reproduction, this spot forms a door that can be removed if anything goes wrong with the mechanism inside.

How a single silent electric motor with-



Drawing, above, of a mechanical cow shows how it is animated by electrically driven motors. Springs in neck give life-like movements to theanimal'shead

Messmore and Damon with the real cow, and, in back of it, the robot that is being made to look just like it

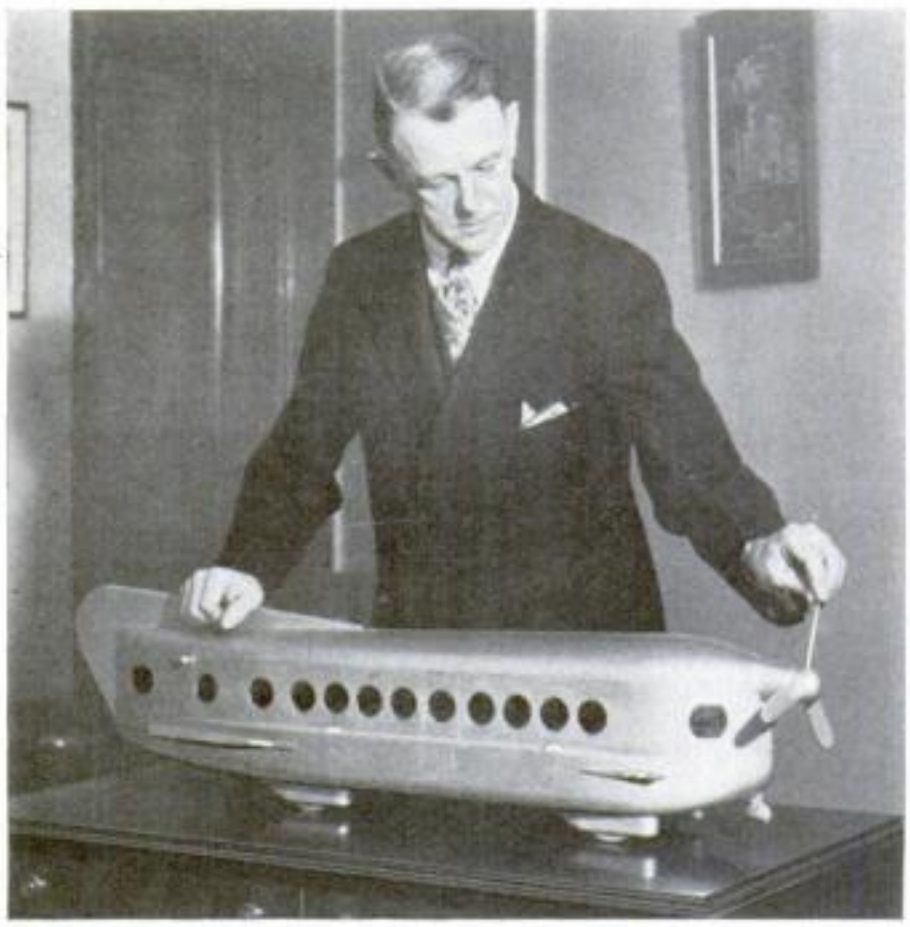


NEW FIRE ALARM LOCATES BLAZE

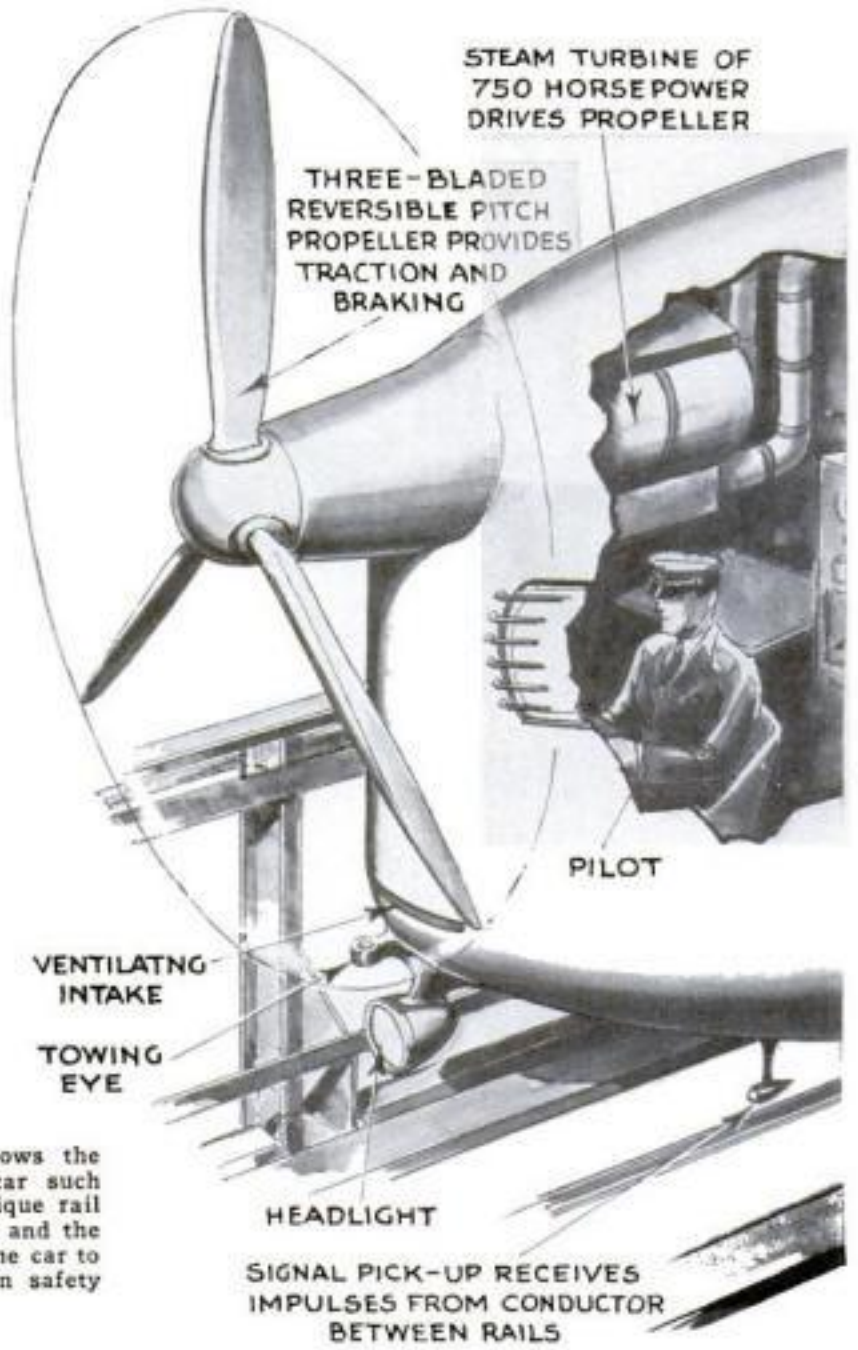
FIRE alarms in Los Angeles, Calif., are answered more speedily as the result of an innovation in signal apparatus. When the handle of an alarm box is pulled, the number and address of the box are automatically recorded upon moving tape at the central station. Reading the information from the tape, as shown at left, an attendant selects a perforated card corresponding to the particular box and drops it in a slot. A coded signal, repeating the box number and address, is automatically transmitted by electricity to the nearest fire company, which responds to the alarm. The new system minimizes the possibility of error and prevents the loss of valuable time at a critical moment, as has occurred in the past, due to the firemen's ignorance of the exact location of the blaze.

Gliding Cars *Planned*

TRAINS THAT WOULD SKIM TRACKS AT HIGH SPEEDS PROPOSED IN



Walter H. Judson, inventor of the flying railroad, with a model of the high-speed coach. The reversible propeller acts as a brake



This cut-away picture shows the details of a high-speed car such as is proposed for the unique rail line. Note the guard rails and the wheels that would permit the car to rise clear of the tracks in safety

IMAGINE a flying railroad in which captive airplanes serve as cars. Skimming through the air, the streamlined cars are expected to attain speeds up to more than 200 miles an hour. A cage of rails restrains them from actually leaving the track.

That is a brief outline of a project for a high-speed transportation system put forward by a New York engineer, Walter H. Judson, pioneer aviator and formerly chief engineer for a railway car manufacturer. In Judson's opinion, all engineering details have been worked out. With the cooperation of makers of railway and electrical machinery, structural steelwork, and airplane equipment, he has prepared a complete plan.

Judson's plan calls for a light-weight structure of steel with a roadbed of trough-shaped cross section. Two bottom rails will be faced with rubber; these will support the flying car, with its pressed-steel wheels, while it lightens itself with increasing speed. A pair of side rails will serve as buffers and prevent sidesway. L-shaped rails at the top will complete the cage and prevent the car from lifting itself completely from the track.

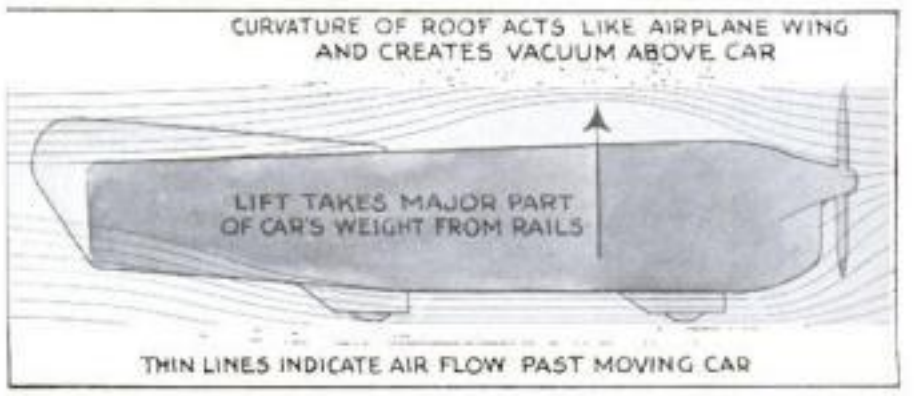
The fifty-foot coach, encased in a streamlined shell of light metal alloy, will resemble an airplane fuselage shorn of wings. Wind-tunnel tests show, Judson says, that the curvature of the roof provides sufficient lift at full speed to raise nearly all of the car's weight from the rails. Guide wheels with rubber tires are expected to restrain the car if it should leave the rails entirely, while similar wheels limit sideward movement.

A compact geared turbine will drive the propeller. Steam is supplied from an oil-burning boiler in a rear compartment, and exhaust steam from the turbine will pass through a condenser, enabling most of the water to be recovered and used over again.

The coach Judson plans would accommodate from thirty-six to fifty-four passengers. Its crew would consist of pilot, mechanic, and porter. There is no conductor.

For transcontinental service and other long hauls, Judson proposes the use of a flying train of from three to ten coupled sections, instead of the individual coach. A power car at the front would pull a string of passenger or freight-carrying sections, ending in a tapered observation car or caboose, at from 100 to 180 miles an hour Judson says. The cars will be coupled in such a way as to avoid wind drag from vacuum pockets forming between them.

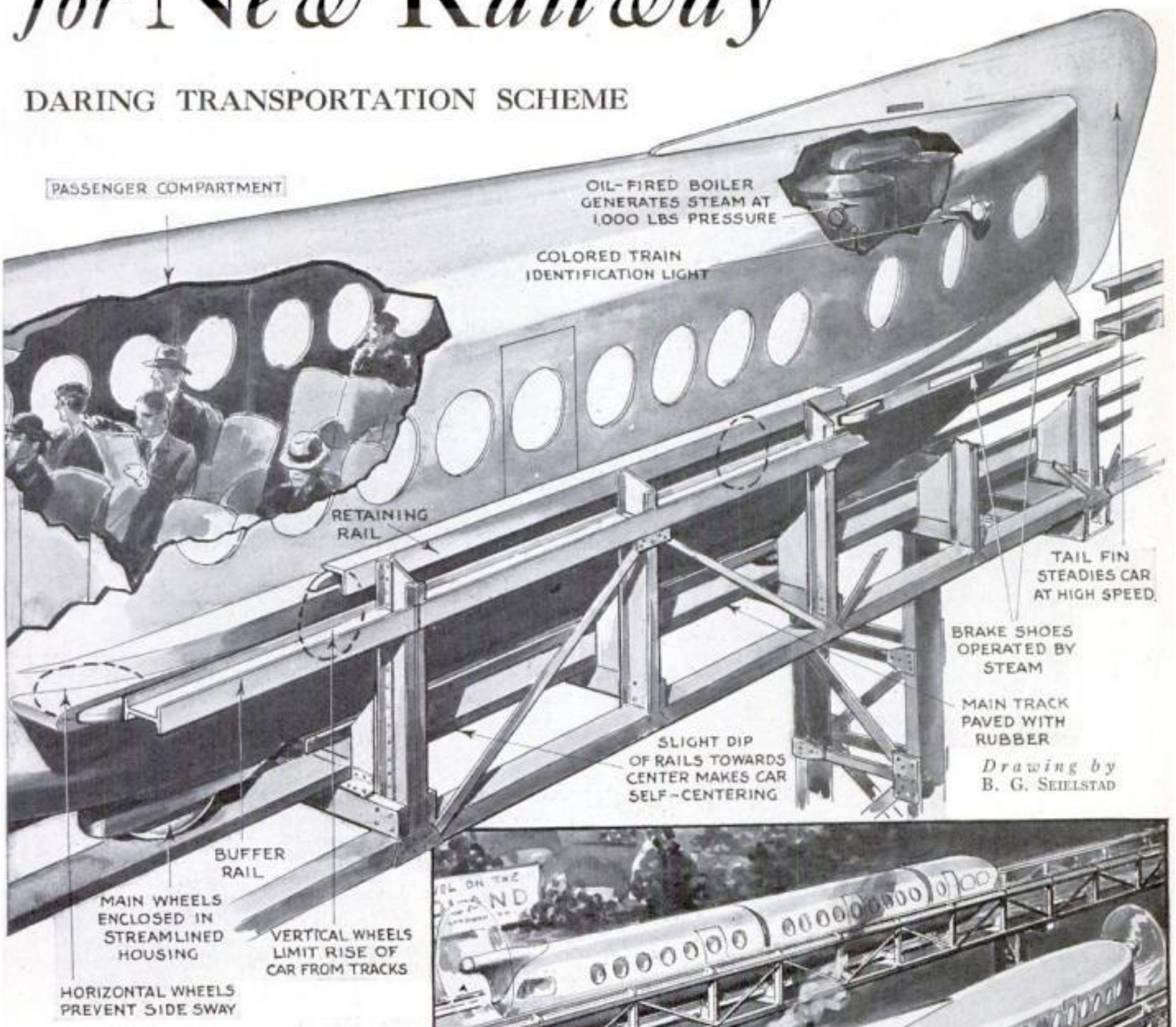
Since an ordinary brake would quickly burn out if applied to a vehicle traveling at such speed, the propeller will be made to serve as an air brake. This will be done

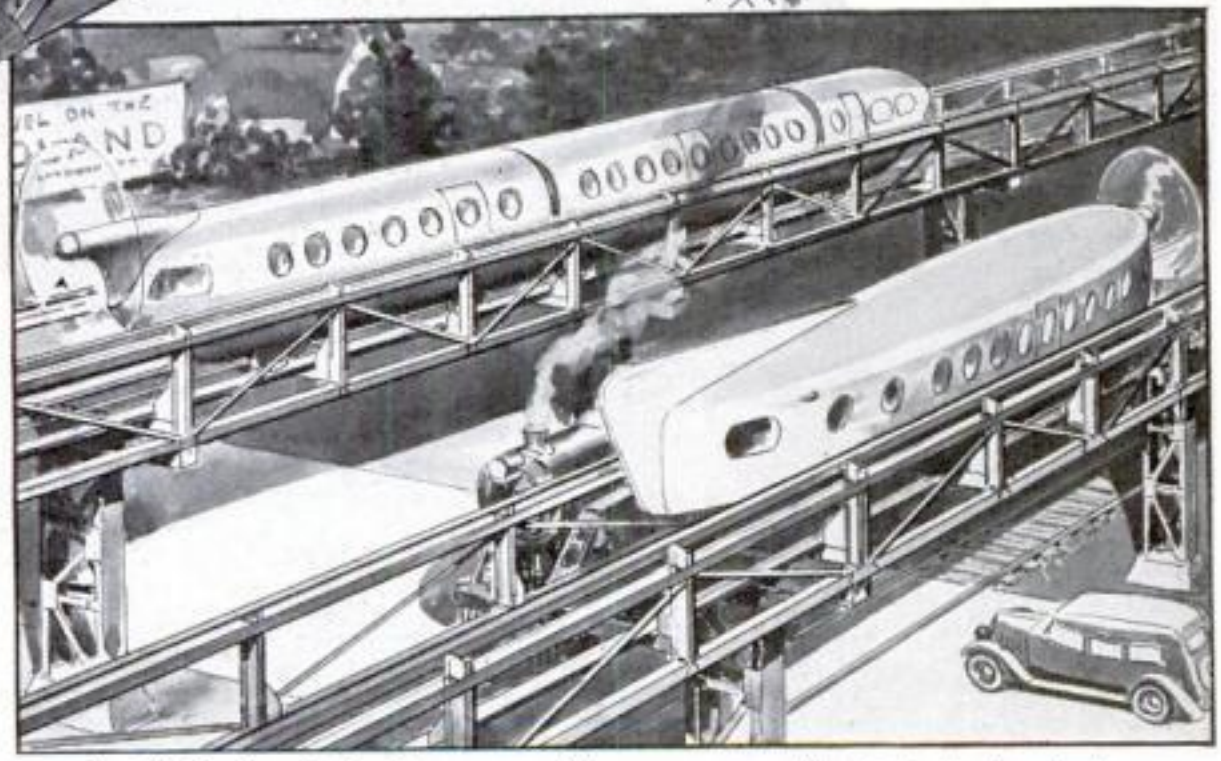


Curvature of car's roof exerts a lift at high speeds, like an aiplane's wing, tending to make car rise from the tracks

for New Railway

DARING TRANSPORTATION SCHEME





An individual coach for short runs and, in rear, a streamlined train for long hauls

by reversing the pitch of the propeller blades so that they push the air ahead of the car and retard its motion. When the vehicle has thus been slowed to ninety miles an hour, steam-operated brakes will be applied to I-beams at the sides of the trough and bring the car to a halt. A full stop from a speed of 200 miles an hour can be made in 7,800 feet, Judson calculates.

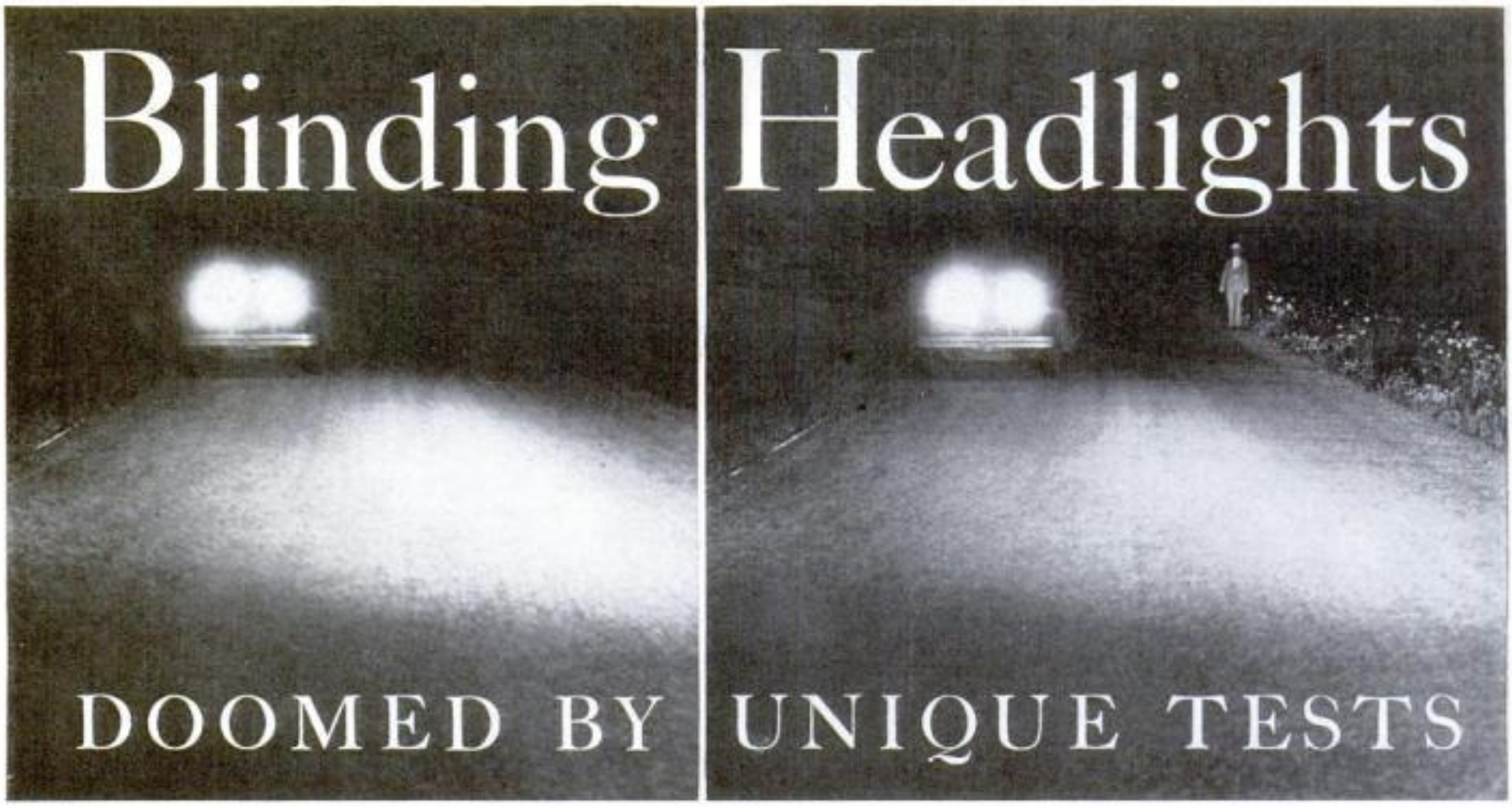
An automatic signal system, he says will make it impossible for one car to approach closer than three miles' distance to another. When a danger signal is picked up electrically from an inductor cable running along the center of the trough, the propeller blades will reverse of their own accord and the steam brakes operate after the proper interval. If any foreign object falls into the runway, an emergency signal is automatically flashed to oncoming cars and the usual action of the propeller brake is accelerated. The pilot has no signals to watch, but can talk with other cars and with the train dispatcher through a "wired wireless" system using the same conductor that carries the signals. These safety features and the absence of any grade crossings greatly reduce the chance of accident, Judson believes.

Windows will be sealed and fresh air provided by an air-conditioning system with an inlet at the front of the car.

Judson announces that a fifteen-and-a-half-mile demonstration line is planned for New Jersey, to serve a community as yet unnamed. Both coaches and trains will be run according to the plan, and will make the trip to a terminal connecting with a New York ferry in six minutes. Commuters and sightseers, Judson says, will be offered an opportunity to use the line, although its principal purpose is to show the feasibility of the system for larger-scale application. He declares its use would bring Chicago within five and a half hours of New York City, and San Francisco eighteen hours from New York.

First of the longer runs contemplated by Judson for his system are lines connecting Jersey City and Atlantic City, N. J., with Philadelphia, Pa.

Blinding Headlights DOOMED BY UNIQUE TESTS



The picture at the left was taken from a car equipped with a pair of ordinary headlights. There is a man at the right side of the road but he is invisible. At right, the situation is the same but camera car had asymmetrical lights and the man is seen

By
Walter E. Burton

NO LONGER need darkness take the wheel when you drive your car at night. Accurate tests have replaced haphazard judgment in designing automobile lighting equipment.

At the Nela Park Laboratories of the General Electric Company, Cleveland, Ohio, engineers are fighting the dangers of night driving. New headlight lamps are inspected and better lenses developed. Special cars travel the roads to test new devices. Scores of spot lights, stop lights, and other lighting accessories are tested each week under actual use.

In the system of lighting used on some of the new cars, V. J. Roper, a Nela Park engineer, sees the solution to one great night-driving danger. A new headlight arrangement, known as "asymmetrical lighting," removes the blind spot formed when two cars pass each other on a dark country road.

This improved lighting system gets its name from the fact that two unsymmetrical beams of light are used. Unlike the usual pair of headlights, asymmetrical lamps are not twins. Although the left headlamp spreads its light over the entire width of the road, the right-hand lamp concentrates its beam on the right half of the road, illuminating the adjacent ditch, curb, and sign boards as well.

For ordinary driving, both headlight beams light the roadway for several hundred feet ahead. When a car approaches from the other direction, the driver of the asymmetrically-lighted car merely touches the button of a conveniently located switch. Automatically, the left-hand beam is depressed or dimmed. At the same time, a second filament in the right-hand lamp, whose beam is unchanged, is thrown into play to increase the light on the right side of the road. A single movement of the driver's hand lowers one beam and increases the strength of the other so that the driver can see the road clearly for several hundred feet in front of him.

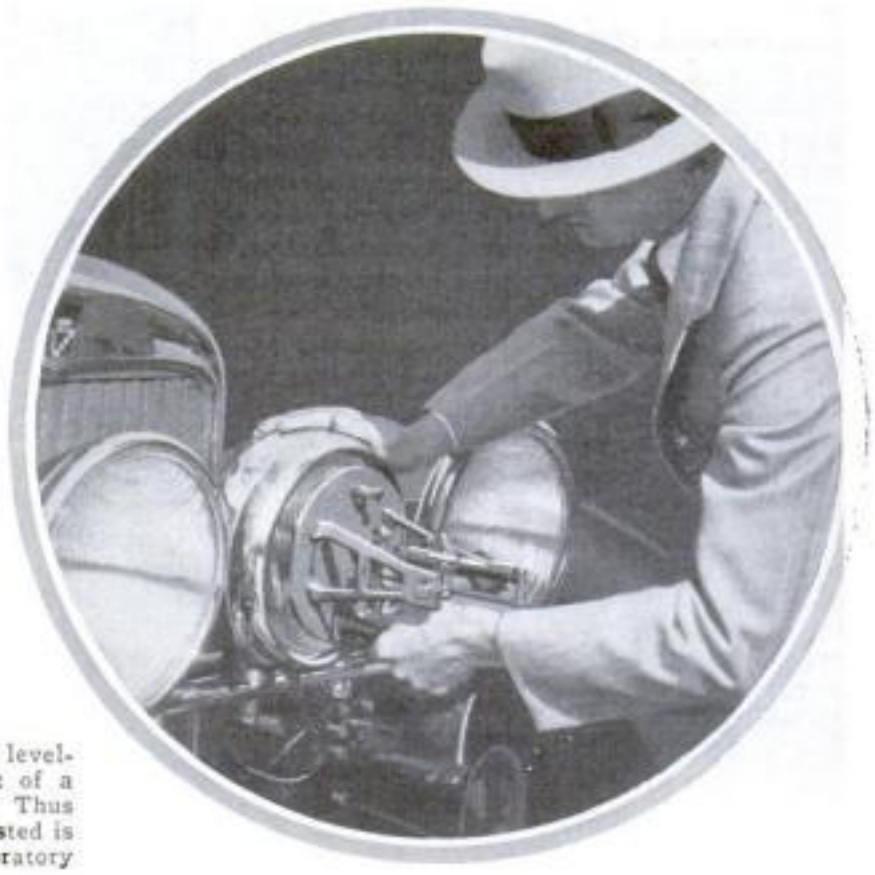
Because of the complicated installation and the use of two totally different headlights, this particular system probably will be available only on high-priced cars. However, a similar scheme that gains the same end is being applied to the less-expensive machines. It involves the use of a double filament lamp in each headlight with an ingenious provision for lowering the left side of the beam without disturbing the right side. The lamps are so constructed that one of them lights the right half of the roadway and the other the left half.

Auxiliary asymmetrical lights also have been designed that can be attached easily to any car having depressible-beam headlights. One simple arrangement consists of two units resembling spot lights. One light, aimed straight down the center of the road, is used only when the driving or elevated lights are on. The other throws a shaft of light along the right-hand edge of the road and is turned on automatically when the headlight is depressed.

Another supplementary system uses a two-filament bulb—one filament provides a beam down the center of the road, the other a beam that strongly illuminates the right curb.

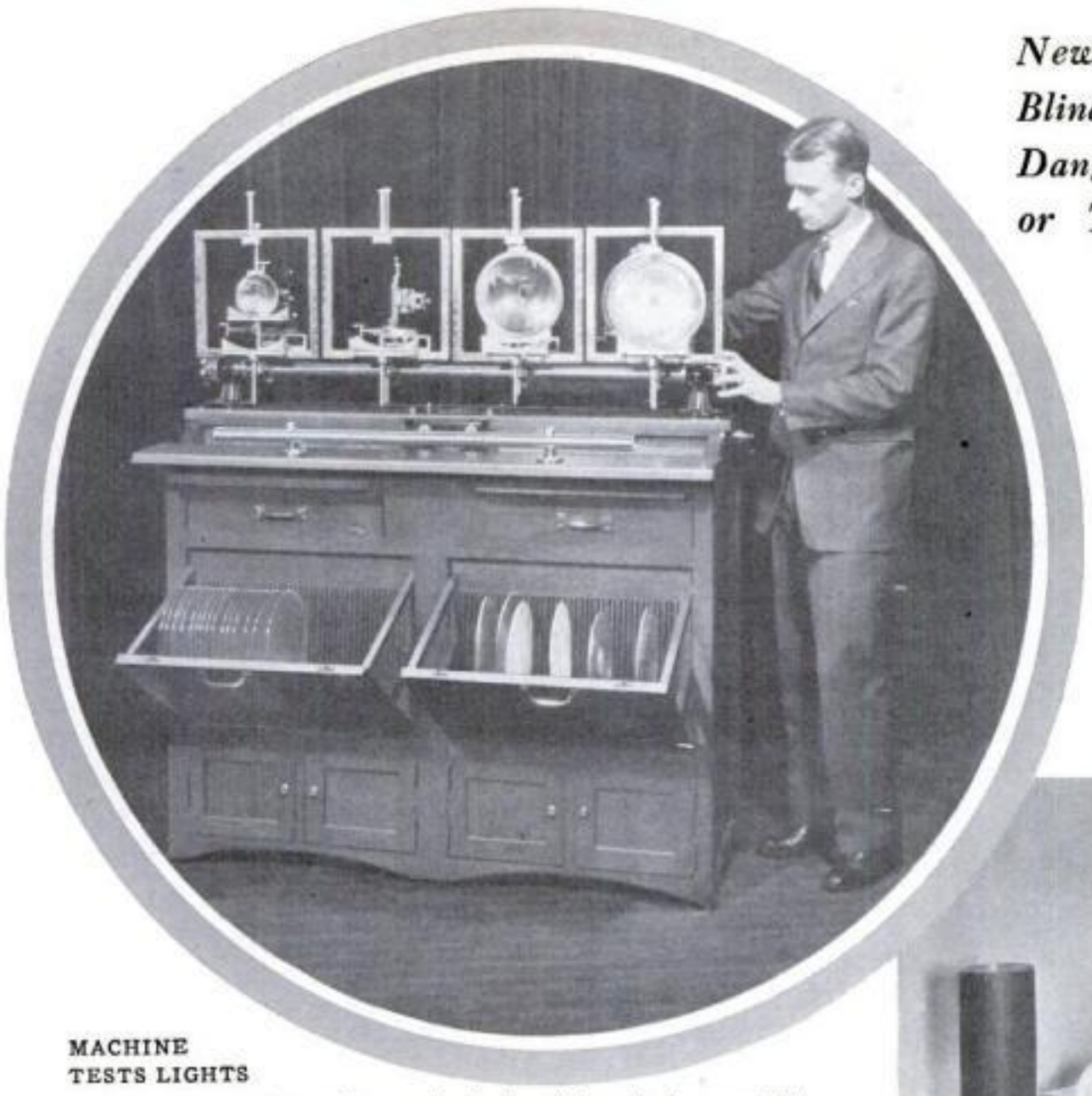
Tests show that any headlight designed to give a good driving light frequently will annoy other drivers. This is due to driving conditions rather than unscientific construction. With two cars placed one hundred feet apart, a deflection as small as one degree will be sufficient to elevate the headlight beam to the eye level of the driver in the other car. It does not take much bouncing over uneven roads to swing the headlights of a car two or three degrees.

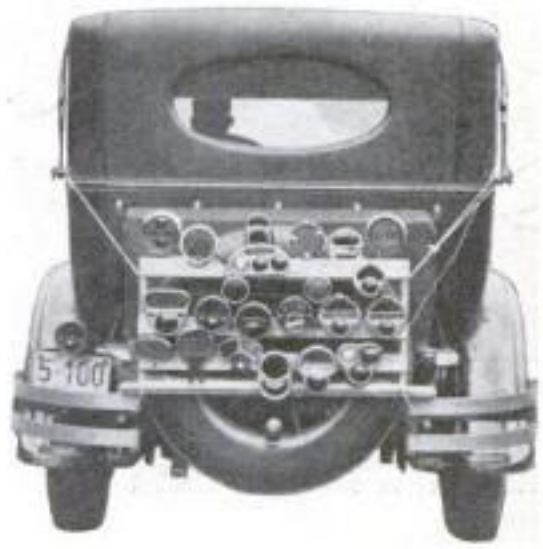
Every year, hundreds of inventors try to eliminate the evils of glare with equipment of one type or another. Yet, the best

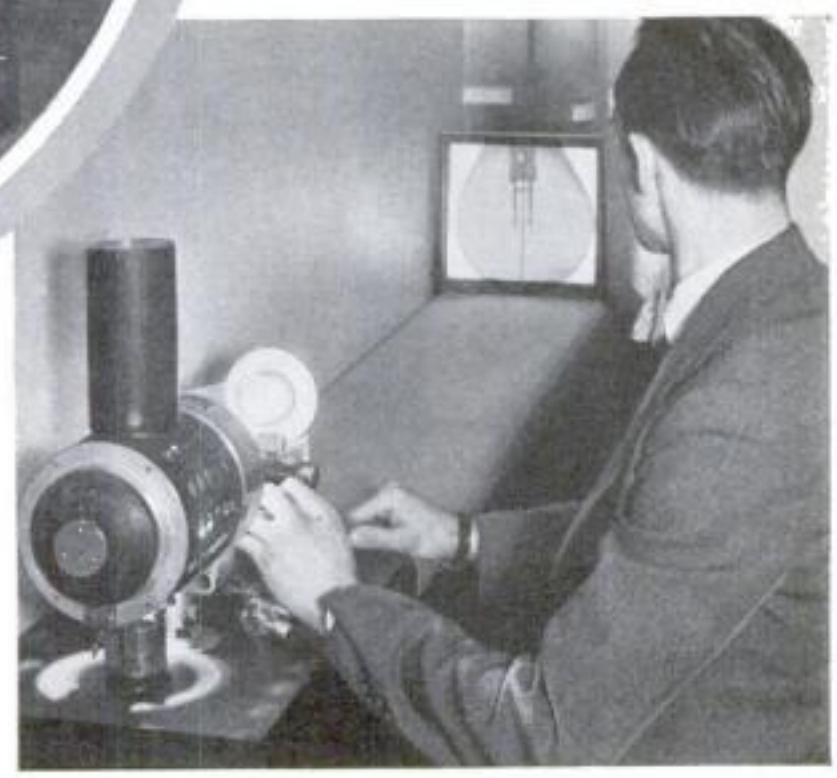


By means of this special leveling instrument, the tilt of a headlight is determined. Thus the angle of the lamp tested is changed outside the laboratory

New Auto Lamps Illuminate Blind Spot and Reduce the Danger of Driving at Night or Through Fog or Smoke







MACHINE TESTS LIGHTS

New lighting equipment for cars is developed through the use of this machine with which various designs are thoroughly tested. At upper right, a car carrying tail and stop lights to determine their efficiency

Filaments in a headlight bulb must be placed to within three one-hundredths of an inch of the scientifically correct spot. When an image of the bulb is thrown on the ruled screen, right, the position of filaments is found

remedy for glare so far discovered is the depressible beam headlight. This holds true in spite of the scores of mirrors, shields, trick bulbs, and other contraptions that have been developed.

Sometime ago, certain manufacturers of bulbs introduced the use of carefully-placed wrinkles in the bulb tip to kill the troublesome secondary images of the filament. Immediately, a small army of inventors devised mirror attachments that form intense secondary images and thus wreck the whole scientific lighting layout. Many devices fail under test because their inventors did not take into account some well-known law of optics.

Great changes have taken place in headlight design. No longer is it necessary for the car owner to bother with the focus of his lamps. Improved methods of scientific lamp and reflector design have resulted in prefocused equipment.

If you compare a new type headlight with one taken from a car two or three years old, you will notice that the reflector is shallower to allow a greater error in focusing without causing trouble. With modern equipment, the beam of the headlight is not impaired until the lamp filament is more than six-hundredths of an inch from its true focal point. Careful design and assembling do not make an error greater than half that amount possible. Practically all the bulbs put out by reputable manufacturers fall well within the limit.

To be sure that lamp bulbs are perfect, the manufacturer tests each bulb and makes any adjustment necessary. At one stage in the construction, the filament is lighted and an image of it is projected on a scale by accurate projecting lenses. This is done while the glass bulb is still hot enough to be plastic. If the filament does not come within the allowable standard of precision, the supporting glass is moved until it does. Such a bulb is bound to give satisfactory service in a prefocused headlight.

Nothing is more blinding than the bright beam from a headlight without a lens. This does not result from the bareness of the bulb but from the fact that a polished parabolic reflector projects a highly concentrated beam. Obviously a carefully designed lens is required to spread this beam and distribute it where it will give the most in lighting results.

Legally, the brightest portion of a headlight beam should not be greater than 50,000 candlepower. A thirty-two candlepower bulb placed in an open reflector, however, may produce a spot of light of 300,000 candlepower—six times the legal maximum.

For this reason lenses must be designed by experts who place the wrinkles, ridges, and slopes where they will do the most good. In the Nela Park Laboratory, special apparatus using paper lenses accomplishes this result.

First, a polished silver reflector is set up in a supporting rack, silver being used in nearly all headlights because it reflects from eighty-eight to ninety per cent of the light. Then a bulb is inserted and focused until a concentrated spot of light is clearly outlined on a screen. The front of the reflector is finally covered with a sheet of heavy paper.

With a sharp pencil, the operator then proceeds to punch holes in various parts of the paper lens. A hole at the top produces a vertical image of the filament on the screen. Another hole punched at one side forms another image, but one lying on its side. Still another hole punched directly opposite causes another lying down image, but one headed in the other direction. Each hole that is punched forms an image in the manner of a pinhole camera.

In this way, the engineer explores the entire plane in which the lens will rest. By selecting only the lying down images, he builds the thin, flat area at the top of the beam that illuminates the roadway some distance ahead. The vertical images, on the *(Continued on page 101)*

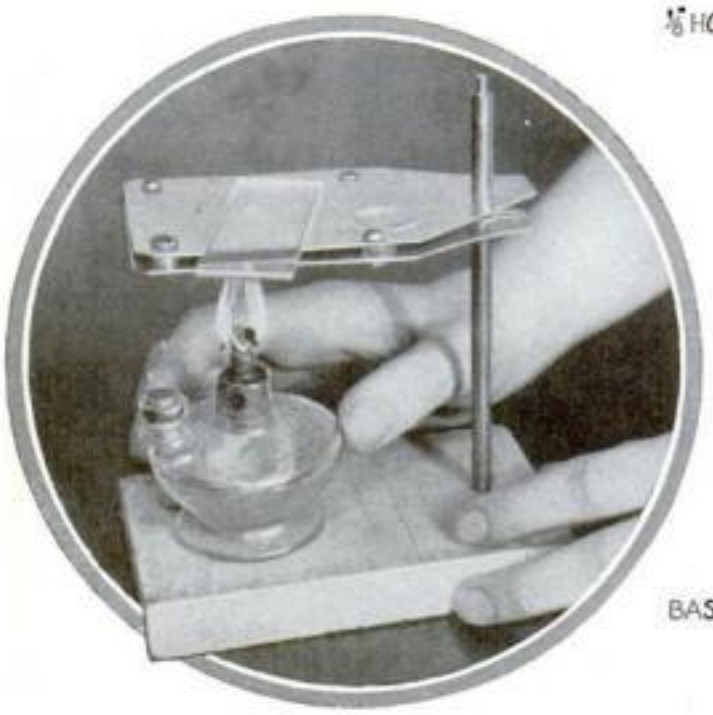
Preserving *and* Filing

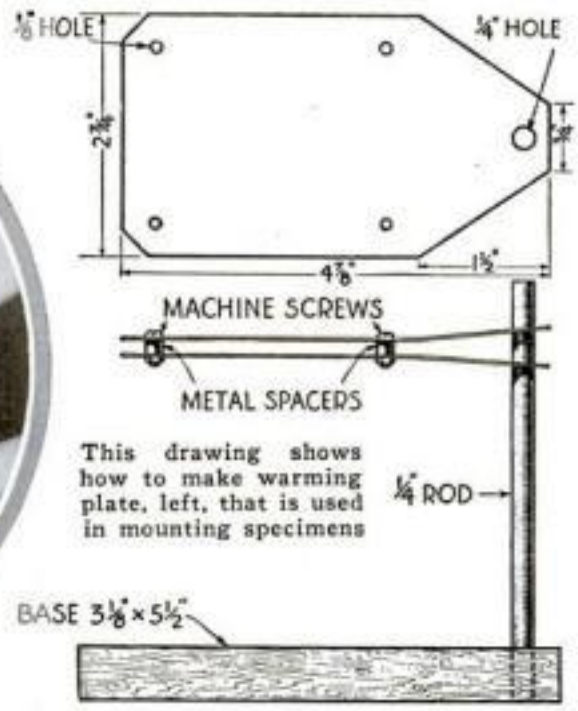
1 In mounting a specimen for your microscope, the first step is the cleaning of the glass slide with a cloth soaked in alcohol

2 Using the forceps, the slide is then laid on the double-bottomed shelf above the alcohol burner and left until it is dry

3 Then the slide is placed on the turntable and a brush dipped in Canada balsam or shellac is used to build a tiny circular cell

4 When the cell is the right size, the specimen, which has been dried over the burner, is carefully laid in the center of the cell





This drawing shows how to make warming plate, left, that is used in mounting specimens

Manner of Making Permanent Record of the Wonders Seen in Your Invisible World Is Described in This Article

By
BORDEN HALL

IN OUR fascinating journeys into wonderland, time and time again, we come upon views so striking that we leave them with great reluctance. It is too bad that we should spend half an hour, say, in the preparation of a specimen only to take one look at it and then discard it when a little more time spent with it would make it ours for years to come.

I believe that many of my readers will like to build for themselves a wonder album, a collection of microscopic views and specimens that can be preserved permanently. This is not only a most interesting indoor sport but it makes our work with the microscope useful and instructive. Also, it permits our family and friends to see what we have seen and to marvel with us.

In an earlier installment, you were told how to make a little device to be used in placing circles of Canada balsam upon slip glasses—the little three by one inch windows upon which we have been placing our specimens for examination and which may be bought cheaply at any biological supply house. This device will be needed along with the scalpel, the needles, cover glasses, and a small camel's hair brush of good quality.

Also, we shall need a little alcohol burner and a drying plate such as is illustrated here. This is easy to make. The double bottom is my own idea. It prevents too rapid heating for, except in rare cases, the topmost piece of metal should not be made too hot to touch with the finger. We shall also want some black asphaltum varnish and some white or clear shellac. With this modest outfit, the beginner may do creditable work in the preservation of specimens.

A word of caution: Don't hurry. Keep in mind that you are mounting the specimens to last, and it is necessary to be careful. Above all, remember that moisture and air bubbles must be eliminated. A slide in which there is moisture will not last and is useless. If we are going to prepare specimens at all, they are worth preparing well and we should not forget that we are learning to do a work that today has a great deal of industrial value. Perhaps if we become proficient in mounting specimens we may be able to continue the work with some great corporation that is constantly trying to improve its product. A great flour mill in Minneapolis, Minn., for example, proudly exhibits more than 30,000 microscopic slides; the result of an investigation that has extended over a period of years and has lowered the production costs and increased the nutritive value of its products.

In a dozen research laboratories today, milk is exposed to powerful ultra-violet light. Then microscopic experts count the dead bodies of the tubercular bacilli to determine the killing power of the rays. Today, the microscope is an indispensable aid to industry.

Our job at present, however, is to prepare a specimen and for our first effort we select what is known as a dry specimen. If we were going to mount the body of a dog flea, we should be dealing with a wet specimen and an entirely different technique would be necessary. To start with, we use the wing of a fly.

The slide and cover glass are carefully cleaned by sponging them off with a piece of soft cloth, free from lint, soaked in alcohol. The slide and glass are then placed on the little warming pan and left there for half an hour. Next the slide is lifted off and placed on the turntable so that the center of the slide is over the shaft of the table. This automatically centers the mounting of the specimen. Under no circumstances should the center portion of the slide be touched with the fingers or any other object after it has been cleaned and dried.

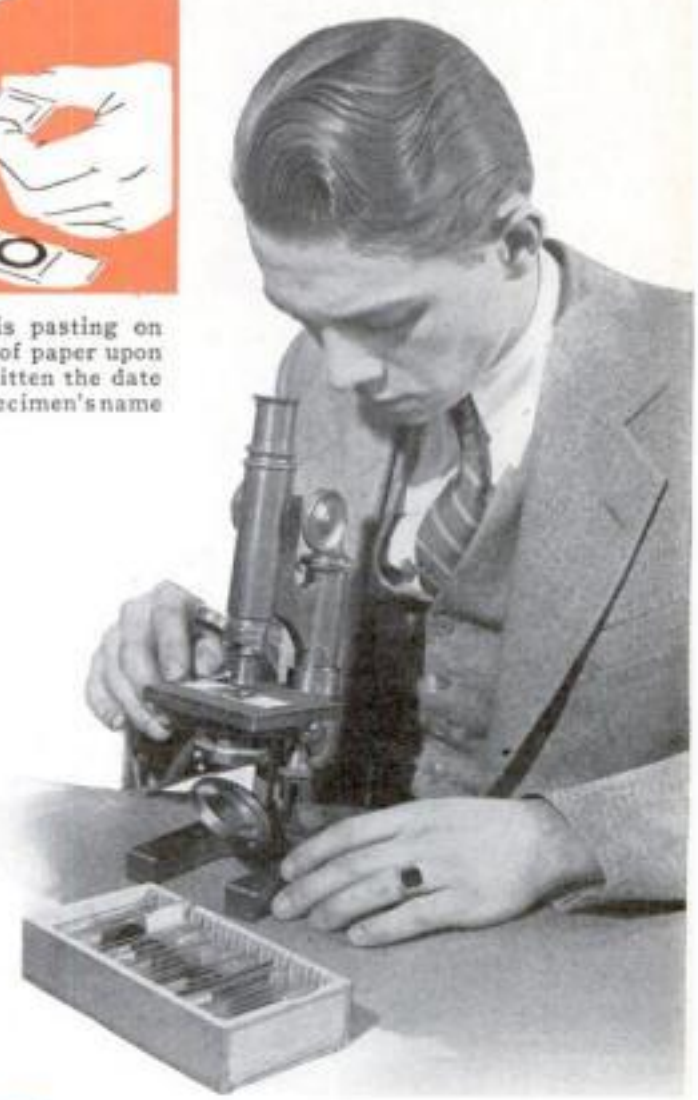
Microscope Specimens

5 With the specimen in place, a cleaned and dried cover glass is placed, with the forceps, on top of the balsam wall

6 The turntable is then given a spin and a brush that has been dipped in asphaltum is held so it seals edge of cover glass

7 The last step is pasting on the slide a slip of paper upon which you have written the date of mounting and specimen's name

With your glass slides properly mounted and filed, your specimens are always readily accessible for study or exhibition to your visiting friends



The little camel's hair brush is dipped into the Canada balsam, which has been dissolved in chloroform, unless you secured your supply from a biological supply house, in which case it was already dissolved. With one hand, the brush is held over the slide at the position near which we wish to mount the specimen. The other hand is used to turn the table. The tip of the brush is brought in contact with the moving table at a point far enough from the center to describe a circle a little larger than the cover glass. These cover glasses are usually 5/8th of an inch in diameter, although different sizes may be obtained.

In this way we make what is known as a cell. The tiny circle of balsam builds up a low wall that will support the cover glass and enclose our specimen. The height of the wall depends upon the amount of balsam we deposited with the brush. If the specimen is thick, we shall have to build our wall higher by letting the first ring of balsam dry and then placing another ring on top of it. In this way, we build up a series of rings until the proper height is reached. That is, until the wall is so high that when the cover glass is put on it will not crush the specimen.

Before a second layer of balsam is added, the first layer should be thoroughly dried by placing the glass slide in a little metal box, free from dust, and then putting it over our little heating pan. We must not forget that we are dealing with objects for the microscope and that if we permit a speck of dust to get into the cell, the microscope will make it look as large as the moon. Then, too, such specks are always the sign of the poor workman.

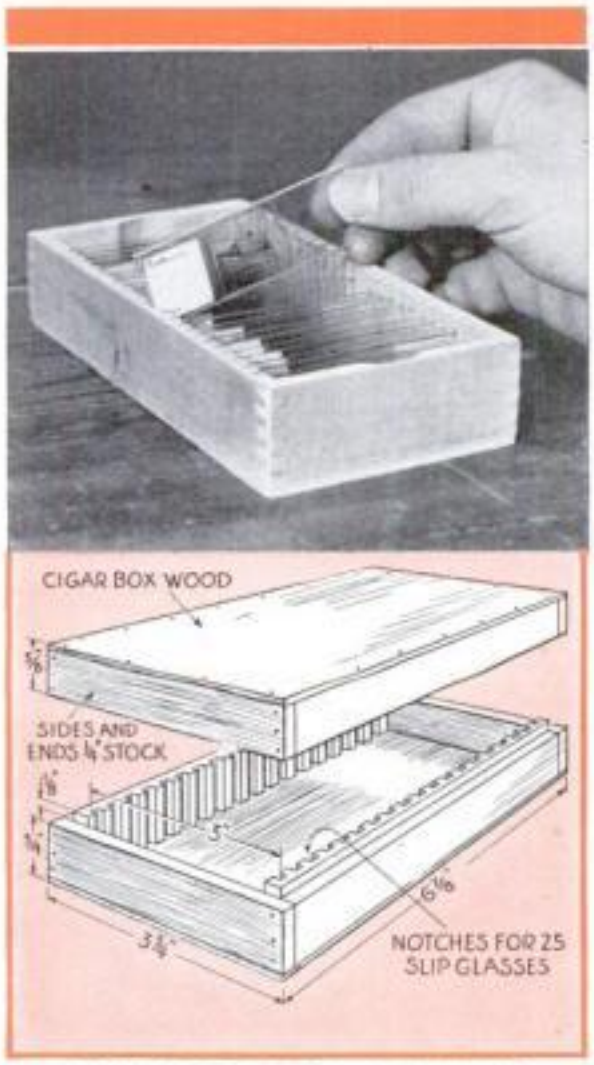
The specimen must be free from moisture. To insure this, we leave it for a few minutes over our little alcohol heater, protecting it from direct heat by placing it upon a clean slip of glass. While this is drying the inside of the cell is covered with a thin layer of balsam which is permitted to become just tacky. Quickly the fly's wing is lifted with the forceps and placed in the center of the cell. The cover glass is picked up and placed over the wing on top of the wall of balsam and the slip glass is replaced on the turntable. A second brush is then dipped in the black asphaltum varnish and the table is spun while the loaded brush is held so that it overlaps the edges of the cover glass and seals the specimen in. Several turns may be necessary to deposit the right amount of varnish but once done and dried, we have our fly's wing locked in so it will keep for years.

This may sound like a lot of work but I have been careful to outline the process in detail. Actually doing it is much more interesting than the description. When the fingers become trained and you have developed a certain amount of skill, you can mount several specimens at a time, so arranging your work that one thing may be sealed while another is drying.

One big mistake the beginner may make is that of using bits of a specimen that are too large. This is the result of our inexperience as we are untrained for work in a world where tiny things are so large. A friend of mine once placed a piece of fungus, the size of a ten cent piece, under a slide when he should have used a bit the size of a pinhead.

Our next job is to mount an opaque specimen, that is, one that must be studied with reflected light. For instance, if we want to mount the inside of a beetle's wing, which is opaque, we cannot proceed exactly as we did in preparing the fly's wing. The cell, however, is built up in the same manner as before. But after the last application of balsam has dried, a small brushful of black asphaltum is placed inside the wall of balsam. While the asphaltum is still tacky, the specimen, after having been carefully dried, or dehydrated, by the application of slow heat, is lifted with the forceps and put in place. The rest of the procedure is the same as that described for the first mounting.

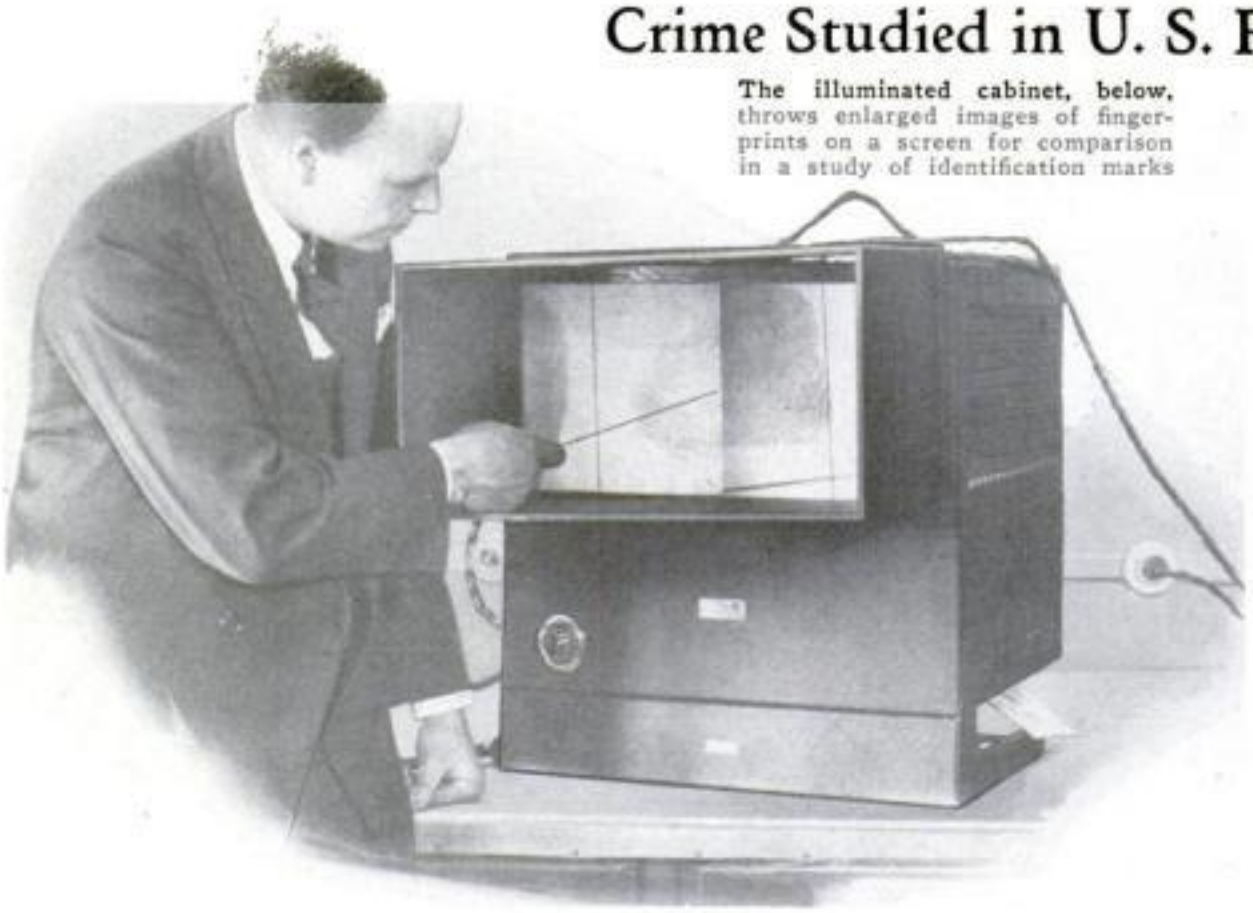
Also, it may *(Continued on page 94)*



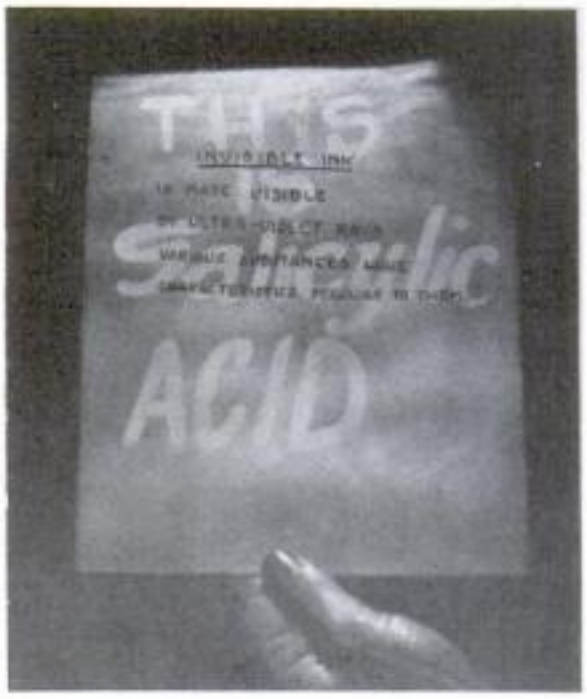
BOXES FOR YOUR SPECIMENS

You can make your own boxes for glass slides by following directions given in this drawing

Crime Studied in U. S. Research Laboratory

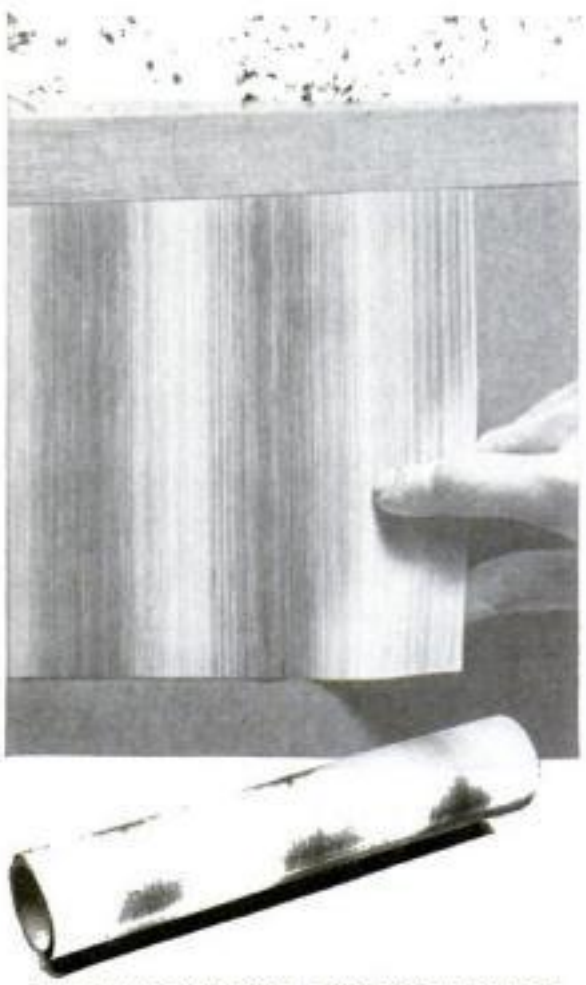


The illuminated cabinet, below, throws enlarged images of fingerprints on a screen for comparison in a study of identification marks



The broad white letters, seen here, are invisible by daylight but show clearly under ultra-violet lamps that detect the secret writing

GOVERNMENT criminologists will seek new methods of scientific crime detection at a research laboratory just established by the U. S. Bureau of Investigation of the Department of Justice. A formidable array of technical apparatus has been assembled in the guarded laboratory, including such varied objects as microscopes, ultra-violet lamps, and sensitive calibrating instruments for measuring the bore of guns. One of the most curious pieces of apparatus that meets the eye of a visitor is an illuminated cabinet in which the fingerprints of a criminal suspect may be compared with those of a known criminal. When the two prints are laid side by side at the back of the cabinet, enlarged images of both are thrown on a screen. The images are so juxtaposed that the lines of one print are seen merging straight into those of the other, permitting instant comparison.

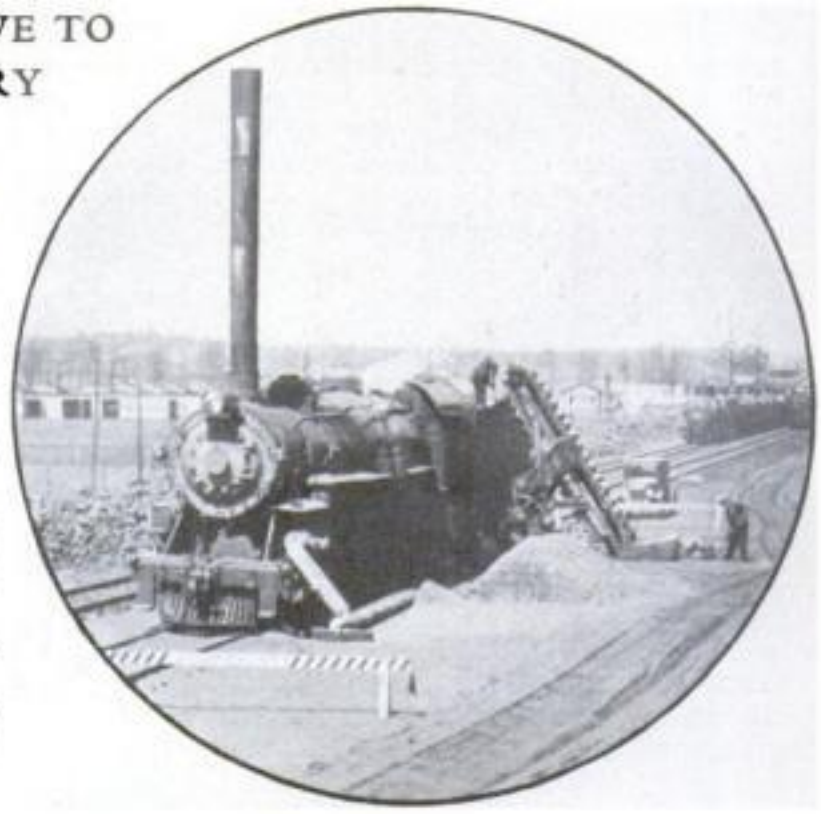


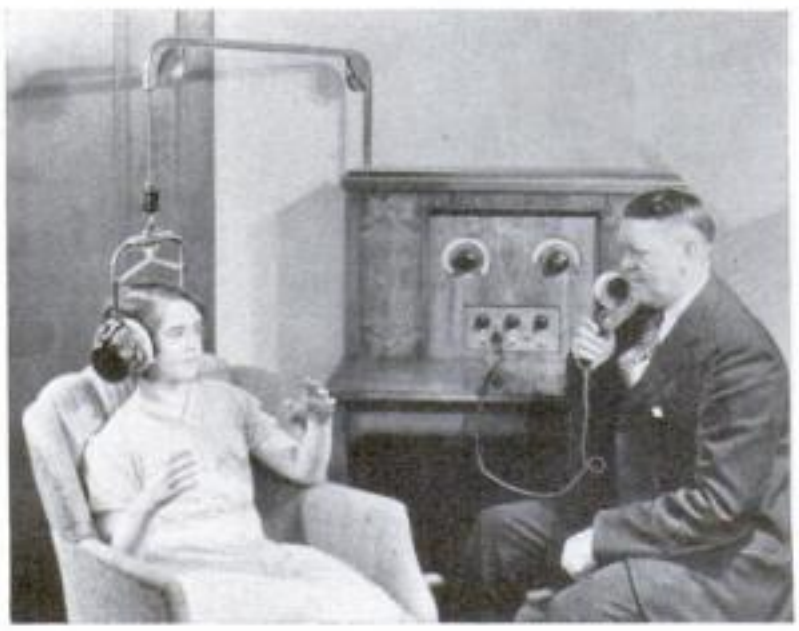
WALLPAPER NOW MADE OF SPUN GLASS

WALLPAPER made by spreading fine spun-glass fibers on a paper foundation is now available. The fibers are laid in one direction and the affect on the eye is that of a multitude of fine parallel lines of shiny brilliancy. Before being applied to the paper, the glass is permanently dyed. Fibers of various colors applied to the same foundation result in gradations of color in bands that blend into one another. It is supplied in standard rolls.

USE LOCOMOTIVE TO RUN FACTORY

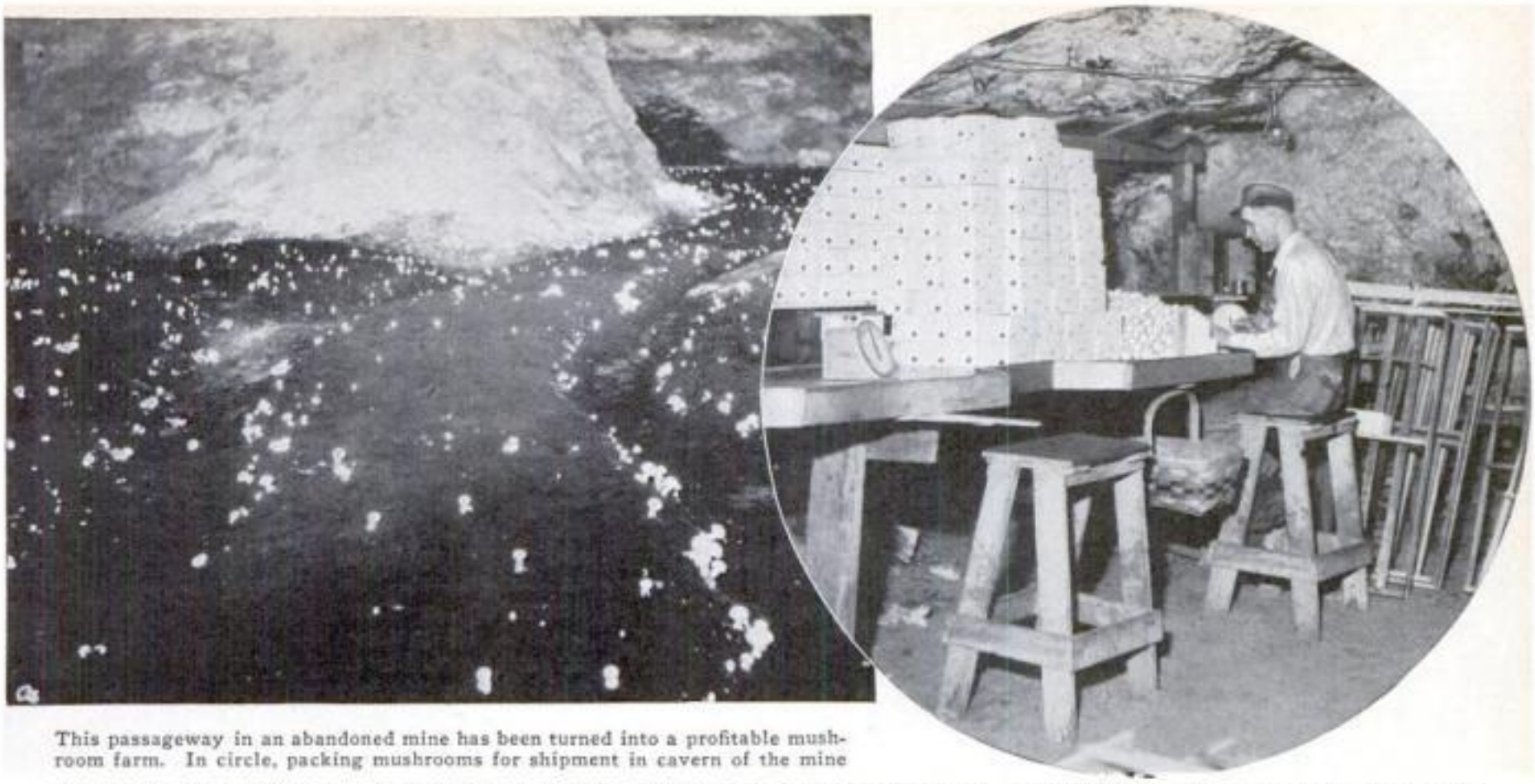
WHEN two boilers of a Newark, Ohio, refinery had to be taken out of service simultaneously for repairs, the company engineer averted an expensive shut-down by using a locomotive to provide emergency steam. The engine, rented from a nearby railroad shop, was run on a siding beside the plant. Piston and cylinder head were removed, permitting the steam to be drawn off for use in the refinery. A temporary smokestack and a traveling-bucket coal loader completed the conversion. For two weeks, the locomotive ran the plant.





EXERCISE EARS TO RESTORE HEARING

AN EAR gymnasium, devised by a Michigan inventor, is said to aid those of defective hearing by exercising the nerve centers of the ear. Special earphones are slipped over the patient's head and at the tone frequencies at which hearing is defective, a series of tone exercises is given at a volume great enough to be heard by the patient. Over a peroid of time, this is said to improve the hearing.



This passageway in an abandoned mine has been turned into a profitable mushroom farm. In circle, packing mushrooms for shipment in cavern of the mine

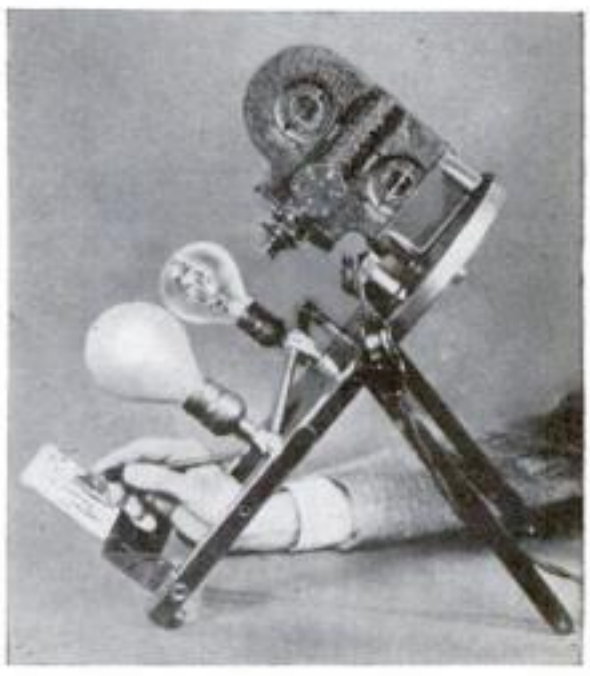
ABANDONED LEAD MINE TURNED INTO MUSHROOM FARM

On a piece of ground 200 feet beneath the earth's surface, Dick Wills of Miami, Okla., is growing regular crops of mushrooms. His unusual farm is the passageway of an abandoned lead and zinc mine, where he found a suitable temperature practically constant the year around. The farm hands wear regulation miners' costumes, even to the small carbide lamps on their heads, for the mushrooms thrive best in darkness. Fifty pounds are harvested daily. A royalty is paid to the owner of the land, an Indian, who is delighted at the resumption of his income since the mine itself petered out.

Powered by a gasoline engine, this machine is being used to pull railway spikes and speed the task of repairing the track

GAS DRIVEN MACHINE PULLS RAILWAY SPIKES

One of the hardest jobs in the work of removing long lengths of railroad track has been the back-breaking one of pulling spikes with the old-fashioned claw bar. Now a machine has been developed that pulls spikes at the rate of twenty-five a minute with slight effort on the part of the operators. As the machine is moved from tie to tie by operating a crank and chain drive at the side, one of the operators slips tong jaws over the spike head and a hook on a lifting arm engages the lug on the tongs. The lifting arm is operated from a gasoline engine.



TITLE WRITER BOON TO AMATEUR MOVIE FANS

Amateur movie-making enthusiasts may prepare their own titles, including animated ones, with the aid of a new title writer. This device, an illuminated stand with an easel at front and a place for the camera at the rear, works in three positions. When set at an angle, as shown above, it permits a hand to be photographed drawing a title. A vertical setting films movable letters for an animated title.

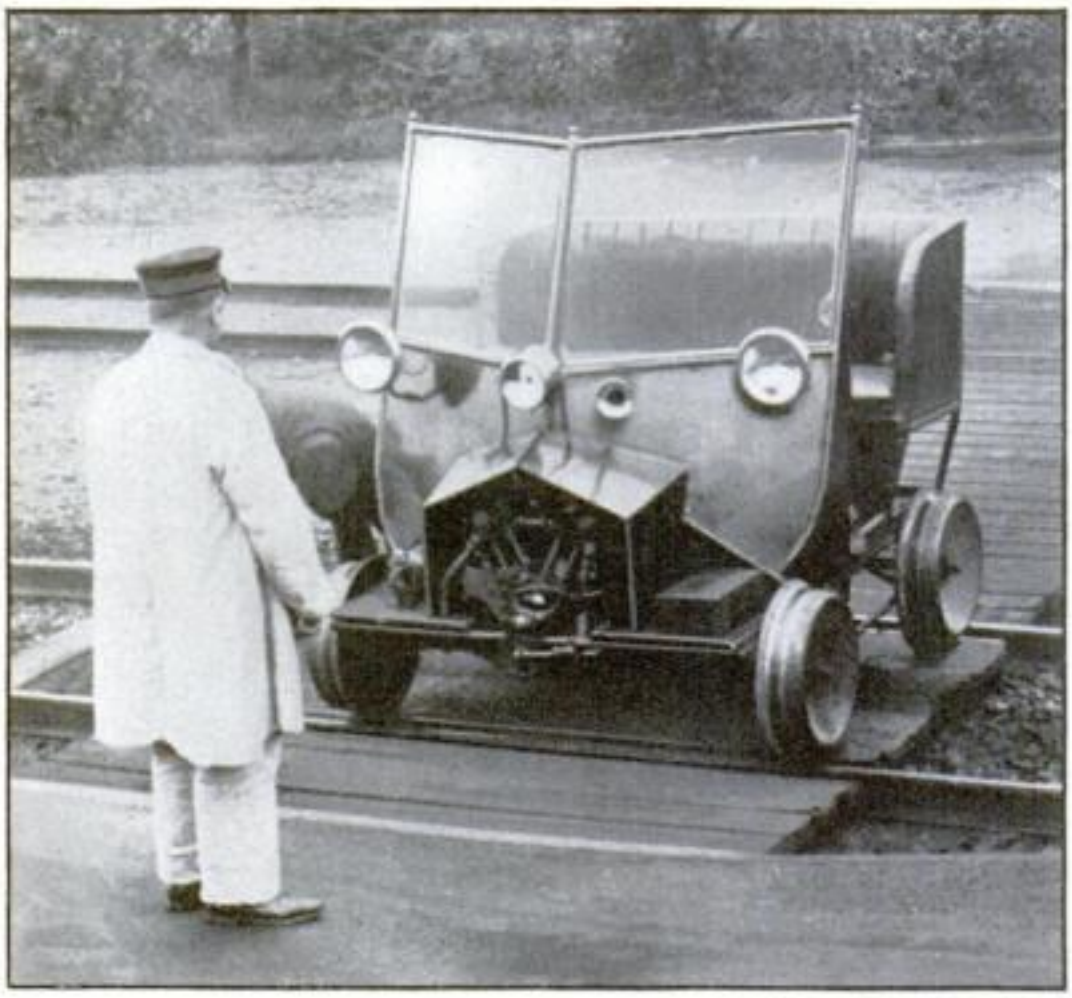
GEOMETRICAL DESIGNS DRAWN WITH TOY

Thousands of geometrical designs, no two exactly alike, may be produced with a toy recently placed on the market. This instrument, an ancient device in modern guise, employs a rotating turntable bearing a sheet of drawing paper and spun with a crank. A pencil in a swinging mount traces the design, as shown at right. Moving certain pegs varies the pattern, which when completed is suitable for coloring with a set of crayons. The arcs produced by the motion of turntable and pencil result in tracings of surprising beauty.

X-RAY FOR WAR USE

Fighting airplanes with X-rays was a possibility forecast recently when Dr. J. W. M. du Mond, of the California Institute of Technology, discharged an electroscope 100 feet away with an X-ray tube. Eventually, he said, the ray might be used to disable hostile aircraft.

Auto on Rails Used by Track Inspector



A HYBRID vehicle, sharing the appearance of an automobile and a railroad handcar, is used by a Danish railway official in making his regular inspections of the road. Flanged wheels adapt the car to travel on the track, while a gasoline motor propels it at a lively pace. Headlights, horn, and a large windshield complete its equipment. The photograph at the left shows the unusual inspection car about to be placed upon the rails.

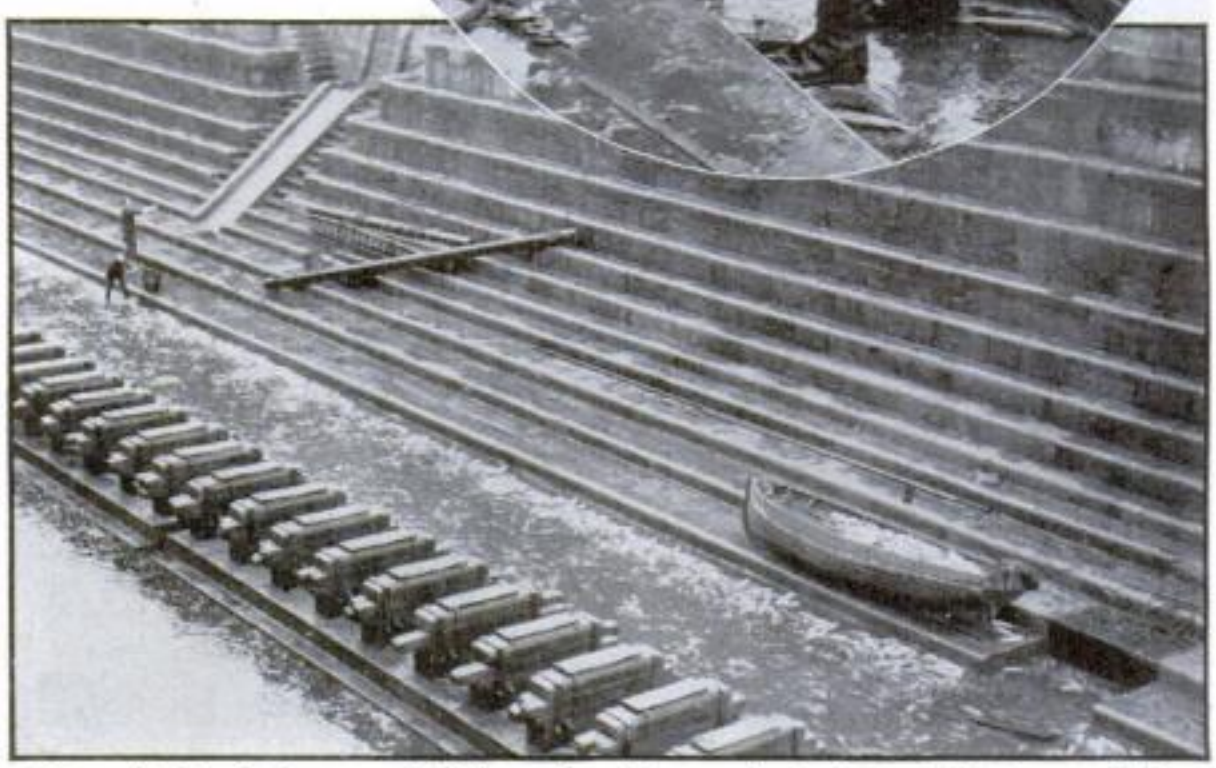
NEW BRICKS HOLD NAILS

NAILS may be driven into novel building bricks of clay developed by a Los Angeles, Calif., inventor and recently placed on the market. This innovation in home building material makes it possible to nail interior fittings directly to the wall. The new brick, half the weight of the standard type, is said to have high heat insulating value.

As photo shows, nails may be driven into this new building brick without cracking it

RECORD FISH HAUL FROM DRY DOCK

A STRANGE fish story comes from Plymouth, England, where one of the largest hauls of gray mullet on record has just been made in a dry dock! While the great basin was being pumped dry, it was discovered that a school of mullet had entered it from the sea. Men with small boats gathered tons of the flapping fish, and negotiations with wholesale fish dealers resulted in the sale of the unusual catch at a profit of $4,000. Thus a dock became history's biggest fish trap.



When this dry dock was emptied it was found the troughs beside keel blocks were filled with fish. Picture in circle, shows how men gathered them in baskets and loaded them into boats

LOUDSPEAKER IN BUS CALLS STREET STOPS

CALLING out street stops is made easy for the driver of a double-deck bus equipped with a new announcing system, developed by Bell Telephone Laboratory engineers. When he speaks into a movable microphone, shown in the photograph above, his voice is made audible by loudspeakers at the back of the bus and on the upper deck. No passenger anywhere in the vehicle can fail to hear him. The microphone, which operates from the car's battery, may be pushed aside when not in use. Since standard switches are not suitable for use on the bus, a new foot operated switch has been designed and is attached in a convenient position on the floor.

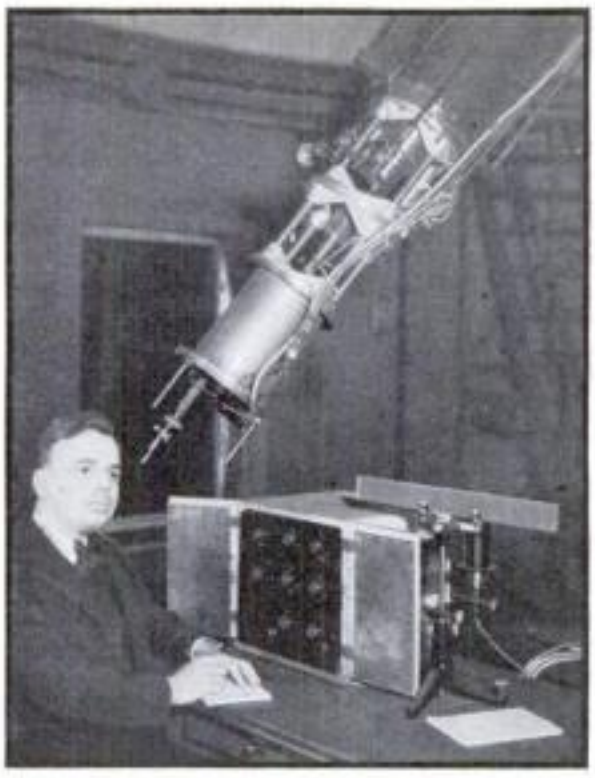


PHOTO-ELECTRIC CELL GAGES STAR'S LIGHT

WHAT probably is the most sensitive instrument of its kind, for measuring and comparing the brightness of faint stars, has been perfected by Dr. Albert E. Whitford, University of Wisconsin astronomer. The light of the star is trained upon a photo-electric cell within a brass cylinder at the end of the telescope, shown in the picture above. The electric impulse produced by the cell is amplified more than 2,000,000 times by the cabinet, resembling a radio set seen in the foreground. The amplified current swings a pencil of light across a scale, and the distance traveled by the light beam is proportional to star's brightness.

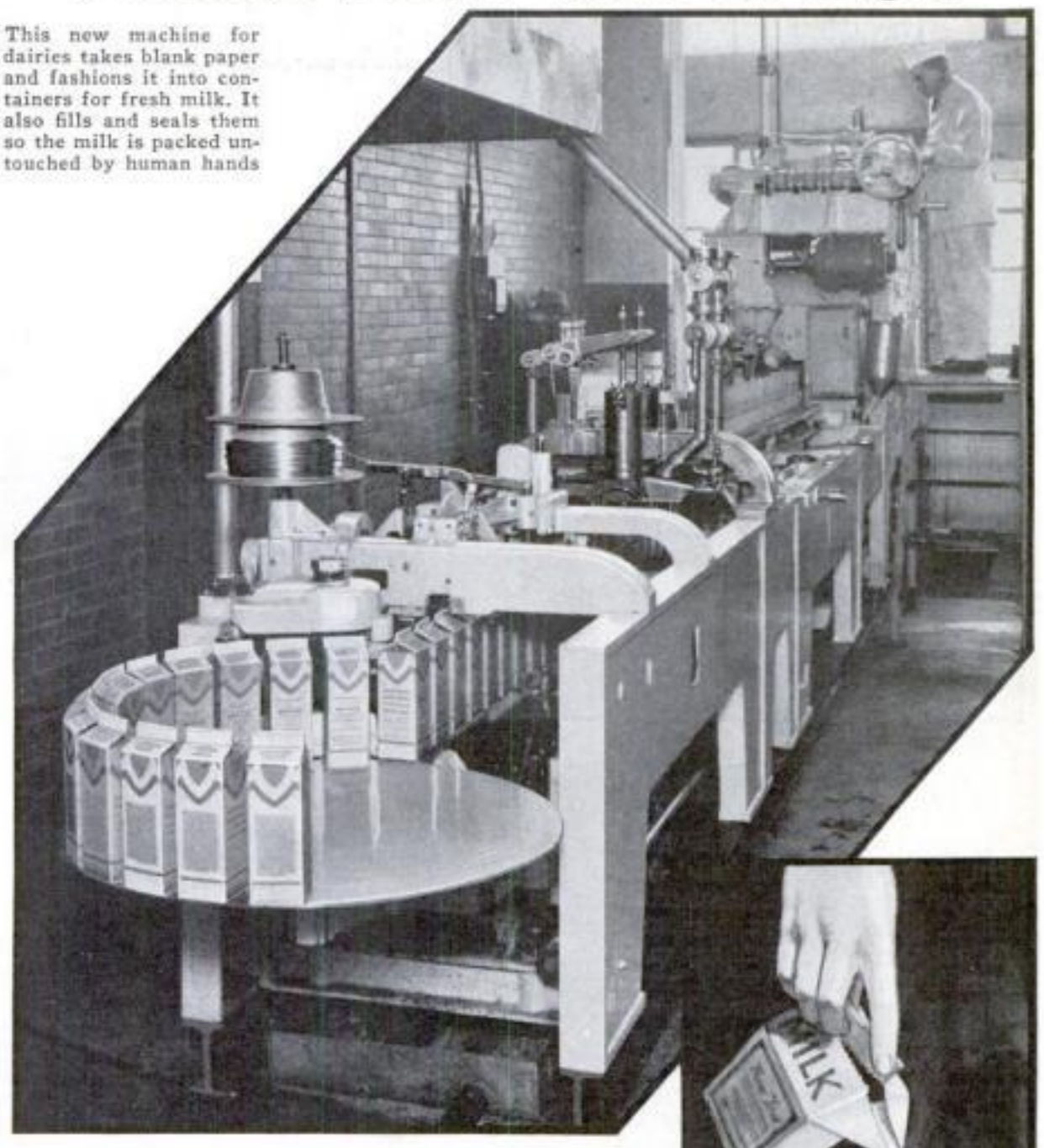
NEW HIGH SPEED LENS BIGGER THAN CAMERA

A NEW lens produced in Germany, larger than a pocket camera, admits sufficient light to take snapshots by ordinary incandescent bulbs. In the rating customarily used by photographers, the speed of the lens is classed as F/O.95; this means that it will make a fully-exposed picture in less than a twentieth of the time required by the F/4.5 lens of a modern high-speed camera. When the lens is installed on a pocket camera, a telescopic sight is used with it.

The big lens used with this camera is so fast it takes snapshots by the light of ordinary bulbs

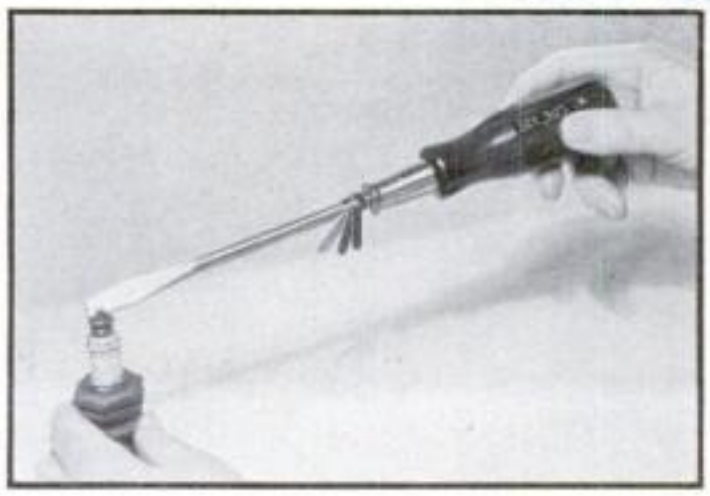
Machine Bottles Milk in Paper

This new machine for dairies takes blank paper and fashions it into containers for fresh milk. It also fills and seals them so the milk is packed untouched by human hands



WRAPPING milk or cream in paper is the unusual feat performed by a new machine for dairies. In one continuous operation, the device forms a container from paper, dips it in molten paraffin, cools it, fills it with milk, and seals it. A consumer receives a boxful of milk untouched by human hands in the packaging process. The paper containers are easily handled and occupy little space in a refrigerator. They are thrown away when empty. The new containers are a substitute for present-day milk bottles of glass, which must be washed and sterilized for re-use, and which are often lost or broken.

The paper bottle for milk forms a handy pitcher when its top is unfolded. At left, a quart of milk and a half pint of cream in old and new containers



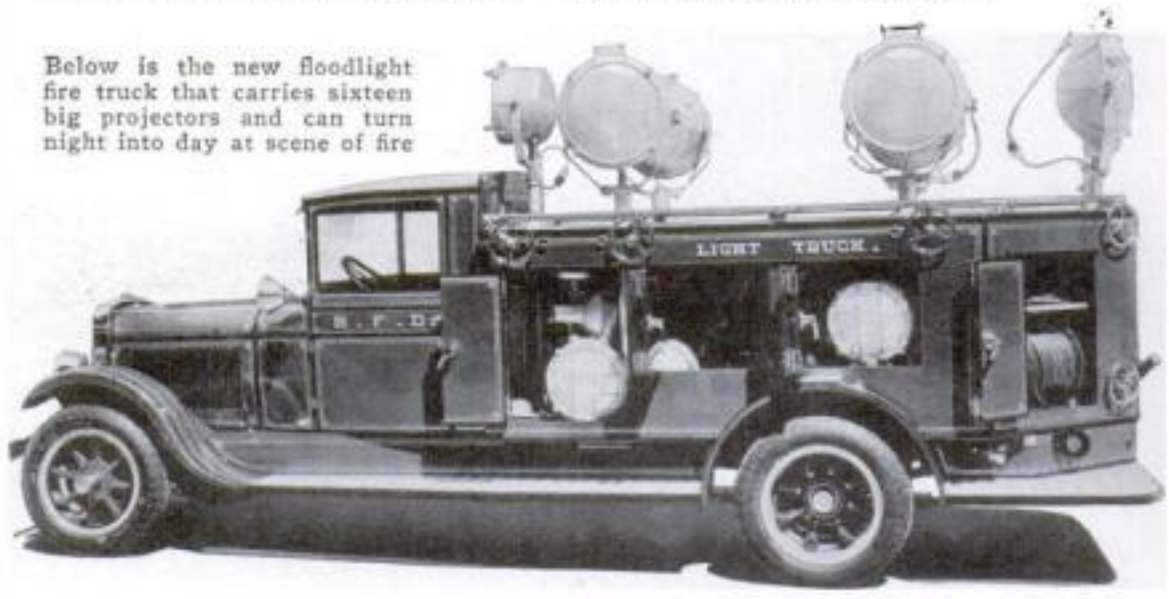
NEW SCREWDRIVER IS SPARK PLUG TESTER

HANDY for testing spark plugs is a new combination screwdriver. When its point is held against a plug as demonstrated in the photo at left, a flash of light, appearing in a window on the handle, shows whether the plug is working properly. The light is produced by a built-in high frequency tube. Hinged gages at the base of the shank aid in spacing plug points.

Fire Truck's Lights Turn Night to Day

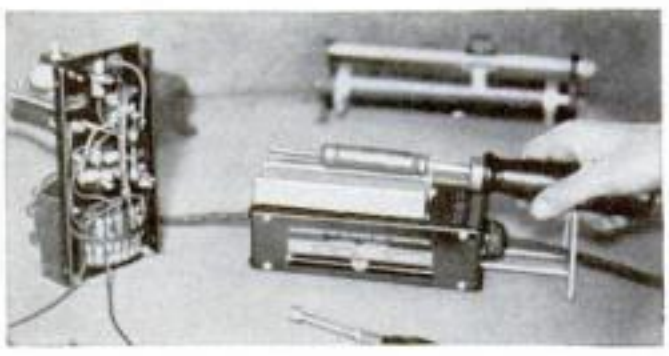
AN EXTRAORDINARY array of lighting equipment is concentrated upon a single emergency truck, recently placed in service by the fire department of Beaumont, Texas. It carries sixteen floodlight projectors and can be rushed to the scene of an alarm to illuminate a building as brightly as day for fire-fighting and rescue work. Six fixed projectors, one throwing a one mile beam, may be raised and lowered within a vertical range of five feet by telescopic mountings on the truck. Electricity to run the lights is supplied by a portable generator that is carried in the body of the truck.

Below is the new floodlight fire truck that carries sixteen big projectors and can turn night into day at scene of fire



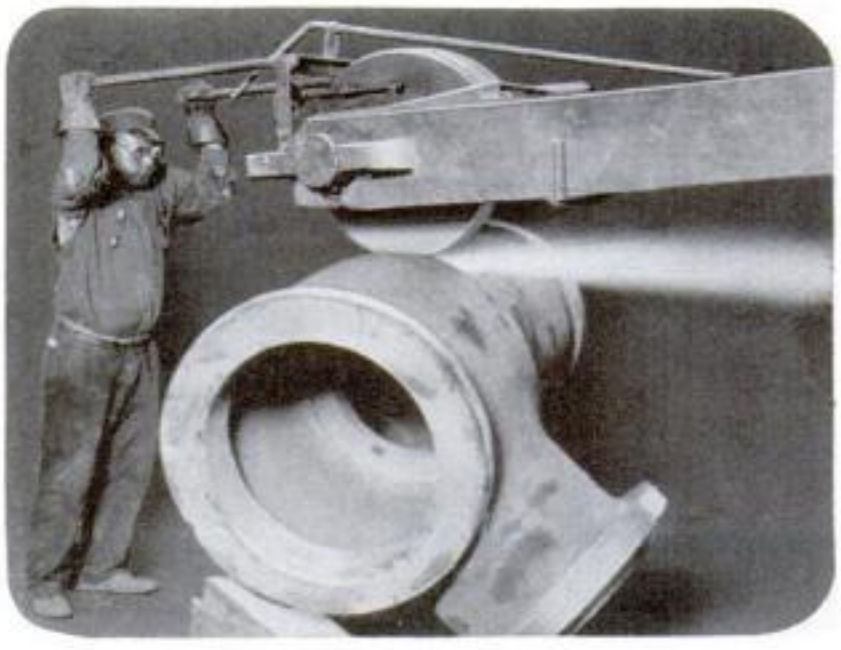
Water Holes Help in Fight on Canadian Fires

WATER holes, like the one illustrated at the right, now help control forest fires along highways on the northern frontier of British Columbia. Should a blaze threaten the safety of motorists, forest rangers hasten to the nearest roadside tank and set up a portable gasoline-driven pump in the manner shown. The stream it delivers from a hose proves an effective means to check a fire before it assumes dangerous proportions. A chain of water holes has been laid out in such a way that the main arteries of travel are all protected.



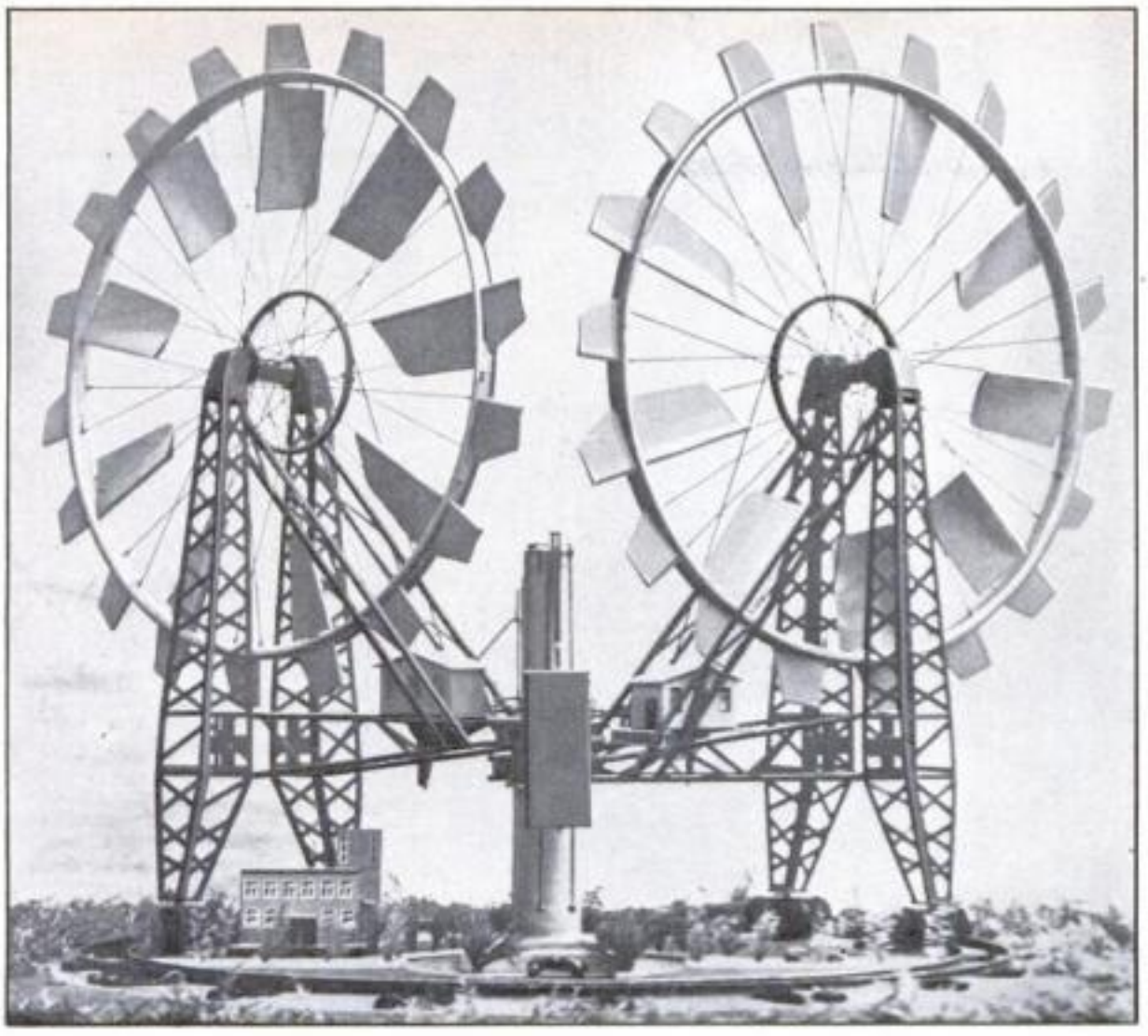
SOLDERING IRON STAND REGULATES THE HEAT

KEEPING a soldering iron at just the desired heat is the service performed by a new stand, which comprises two cradles. When the iron is first connected, it is placed in a cradle marked "Hot Iron." Here the full voltage is applied to the iron and it heats up rapidly. Once the iron is heated, and again between soldering operations, the tool is laid on the second cradle, marked "Warm Iron." The weight of the iron, in this cradle, automatically introduces an electric resistance into the circuit and cuts down the amount of current to a point just enough to keep the iron hot. Stand and accessories are shown above.



FAST ABRASIVE WHEEL SMOOTHS CASTINGS

SPINNING so fast that its surface travels at more than 100 miles an hour, an abrasive wheel, in the machine pictured at left, removes snags or projections from heavy castings. Removing these blemishes, usually the result of an imperfect mold, has hitherto been considered a troublesome operation, but the new machine, with its single operator, makes short work of them. A bonding material of great strength, developed through recent research, holds the wheel together and enables it to rotate safely at high speed.



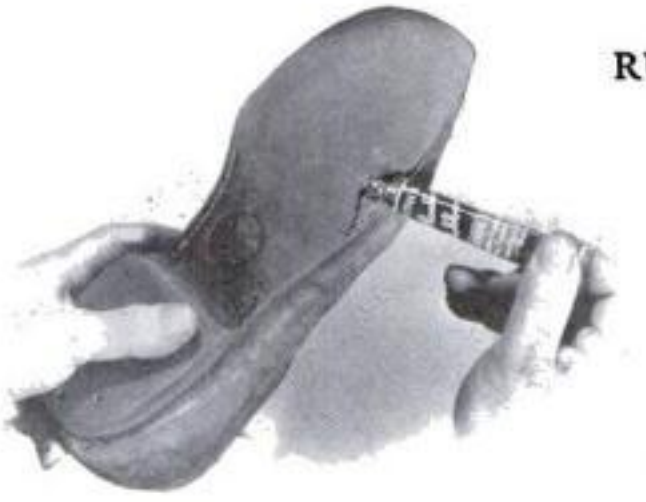
TWIN WINDMILLS RUN ON ROUND TRACK

TWIN towers would harness the wind in a giant type of windmill proposed by a Frankfort, Germany, engineer, who has embodied his idea in the model illustrated above. Instead of pivoting the windmill disks on a vertical shaft to swing into the wind, he would support them with carriages on a circular track 260 feet in diameter. In this way, the inventor maintains, the two wheels would swing around automatically to obtain the maximum power from wind in any direction.

FLEXIBLE STOPPER CUTS OFF FLOW OF GAS

AN INGENIOUS stopper, devised by a New York inventor, H. L. Peden, permits the flow of gas in a main to be cut off temporarily at any point during repairs. The stopper, a collapsible disk of flexible material, is inserted in the main through a tap hole. When a crank is turned, a metal cable draws the plug into a vertical position and expands it so that it fits snugly around the inside of the pipe wall. Once placed, the stopper is locked to prevent slipping or blowing out.

Demonstrating the new stopper for gas mains. The disk is inserted through a hole drilled in the pipe. At right, when the crank is turned, a metal cable draws the disk into position and forces outward arms to hold it

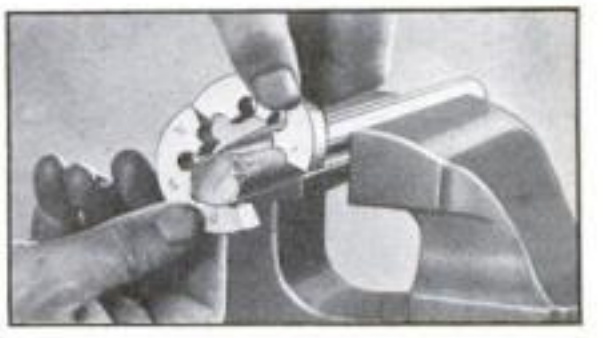


RUBBER IN PASTE FORM

SUPPLIED in tubes like tooth-paste, a new form of rubber, of paste-like consistency, hardens after exposure to air. The product has a wide variety of uses, particularly for mending. As shown at the left, it may be used for patching the sole of a shoe. Industrial users also find the material adapted for such purposes as packing the stuffing-boxes of valves.

LEVER LOWERS CAR'S REAR CURTAIN

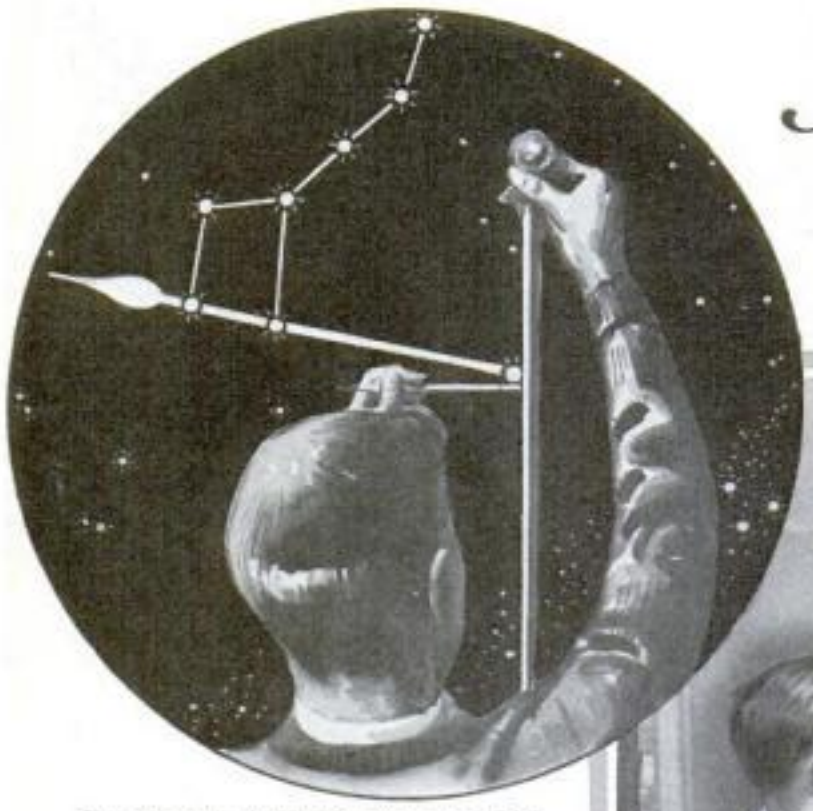
CAR OWNERS can now have a control that operates the rear curtain from the driver's seat. A small lever is set in the car body within easy reach, just above the left-hand window. By moving it along a slot, as illustrated at the left, the driver may lower the curtain whenever lights from the rear annoy him. In case he wishes to have the rear window unobstructed he can raise the blind by working the lever.



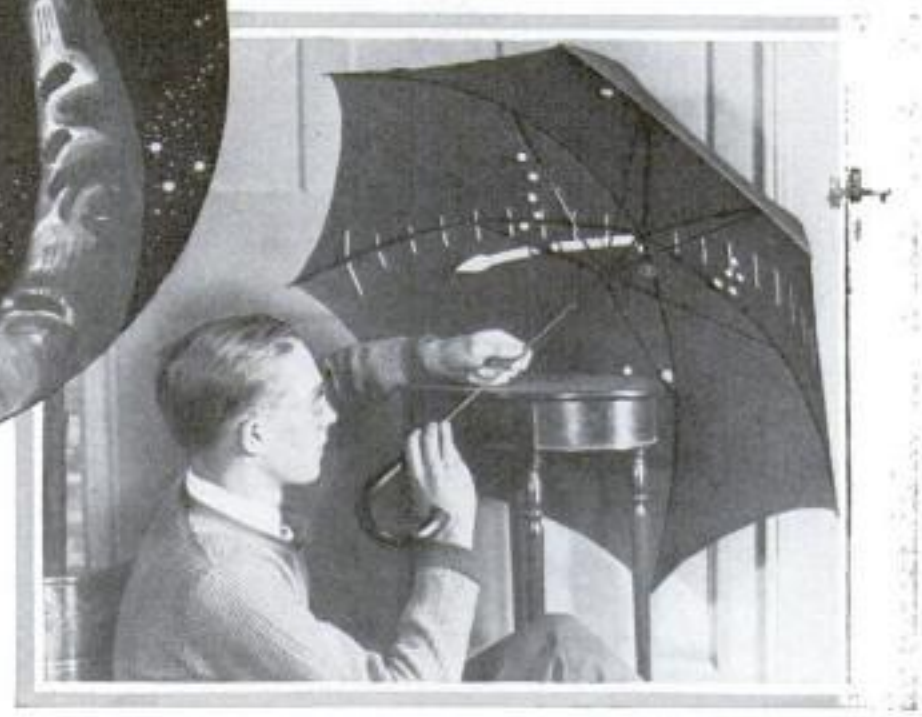
NEW RE-THREADING DIE

MACHINISTS know the difficulty of starting a one-piece die in order to cut new threads on a bolt, when the old ones have been damaged. A new re-threading die, hinged in two pieces, may be applied to the threads at some distance from the point of damage as shown above. With the aid of a special ratchet stock, the die is then worked off the bolt, repairing the mutilated threads by a back-cutting movement instead of an advancing cut.

How to tell TIME



To tell time from the stars with appreciable accuracy run an imaginary line, as the clock hand, from the polestar through the pointers of the Big Dipper. Then a perpendicular line is raised, as shown. A horizontal line is drawn at right angles to it. Each line touches the polestar. Thus the angle of the clock hand to the horizontal can be judged to get the time



This diagram shows the position of the star clock's hand, a line drawn from the polestar to the pointers of the Big Dipper, at nine o'clock on July 1 and also the position of this line six hours later. At left, by pasting a paper hand to the umbrella that bears your star map, the position of the star clock's hand is easily kept in mind

SUPPOSE you are sleeping out under the stars in a vacation camp some night next summer. For convenience, imagine that it is July 1. You awake and wonder what time it is.

A glance at your radium wrist watch tells you it has stopped. You forgot to wind it. You think it must be some time between midnight and morning, but you are vague as to the exact hour.

In such a situation would it occur to you to consult the Great Star Clock in the northern sky? It tells time to the whole world through every clear night of the year, but almost no one ever consults it. Yet it is often pleasant or convenient to be able to tell time by the stars. Sometimes, as in the World War, it might mean a difference between life and death.

Once you have learned to find the hand of the Great Star Clock, at any month of the year, the method is simple. Let us see how it works on the night of next July 1.

On this particular evening, about nine o'clock, you would see the Big Dipper hanging down at the left of the polestar. The dipper looks as if it were hanging by its handle from a nail. If you draw an imaginary line through the dipper's pointer stars and the polestar, the line will run horizontally from west to east. This line is the hand of the Great Star Clock. A paper hand, cut out and stuck to the umbrella fabric, as shown in the illustrations, will help to keep the various positions of the star clock's hand clearly in mind.

Now suppose that you had known that the dipper hangs on its nail at the left of the pole at nine P.M. What difference would it have made to you when you woke and found your watch stopped?

It would have made just this difference—you would have been able to tell the time of night to within a few minutes of watch accuracy, by a glance at the position of the star clock's hand.

Suppose, for instance, that when you woke the hand pointed straight down from the polestar to the horizon, where the dipper stood solidly on its bottom. What hour would that indicate?

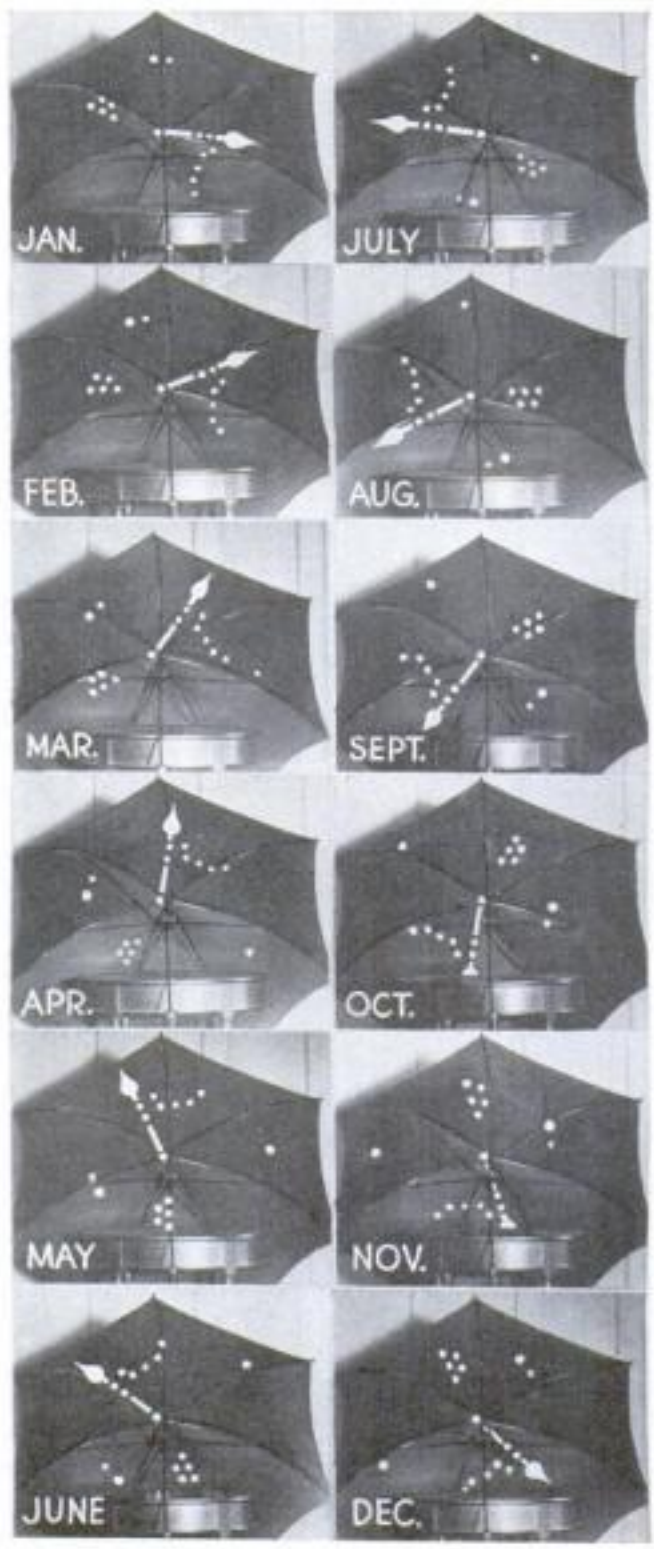
Remember the dipper makes a complete revolution around the pole in twenty-four hours. How far, approximately, would it turn in six hours? Obviously, a quarter way round. And since the hand of your star clock has also travelled a quarter way, it is plainly nine o'clock plus six hours, or three A.M.

If you wish, you can imagine the face of the star clock divided into twelve parts, like the dial of your watch, but you must remember that each of these twelve divisions is nearly equal to *two* hours. In other words, you must eventually divide the dial into twenty-four parts, for the hand requires nearly twenty-four hours to traverse the entire circuit.

You have been wondering, probably, why I used the word "nearly" in the last two sentences. It was necessary because the dipper actually completes its circuit of the

THIS CLOCK NEVER RUNS DOWN

The illustrations at right show the position of the star clock hand at nine o'clock on the first evening of each month. Notice that the hand turns in a counterclockwise direction and in one month it moves one-twelfth of circle's entirecircumference



By Gaylord Johnson

by the STARS

Clock in the Heavens Easily Read on Any Clear Night, Any Place in Northern Hemisphere, if a Few Facts Are Learned and Kept Constantly in Mind

By sighting accurately the disappearance of a star behind a given object, in this case a triangle of paper, at a definite hour each evening, you can check the accuracy of your watch since the star will vanish three minutes and fifty-six seconds earlier each night

pole in a little *less* than twenty-four hours. To be exact, the star clock's hand comes round to the same point again in twenty-three hours, fifty-six minutes and four seconds. If the dipper starts at 9 P.M. from its position at the left of the pole, it will be back in the same position the next evening at three minutes and fifty-six seconds *before* nine o'clock.

This daily gain of a distance requiring about four minutes to cover has an interesting result. It means that in thirty days the star clock's hand has gained a distance which it requires two hours to traverse. This space is just equal to one-twelfth the distance round the dial! You can see at once that the hand will occupy a different position for every month. Our star clock has now turned into a star calendar.

In the illustration of our umbrella sky on this page, are shown the position the star clock's hand occupies on the first of every month at nine o'clock in the evening. As you become familiar with the nine o'clock positions of the dipper in the various months, it becomes a simple matter to calculate the hour from any other position you may observe in the sky.

The only difficulty in telling time accurately by the stars lies in judging the angle the hand of the clock makes with a vertical or horizontal line. The best way to do this is to hang a cane from the fingers of one hand so that its edge just touches the polestar. Then a pencil is placed at right angles to the cane so that the star rests exactly in the angle thus formed. This makes it easy to note the slant of the line from the dipper's pointers to the polestar—and to estimate the angle by which the hand differs from its position at nine P.M. for that month.

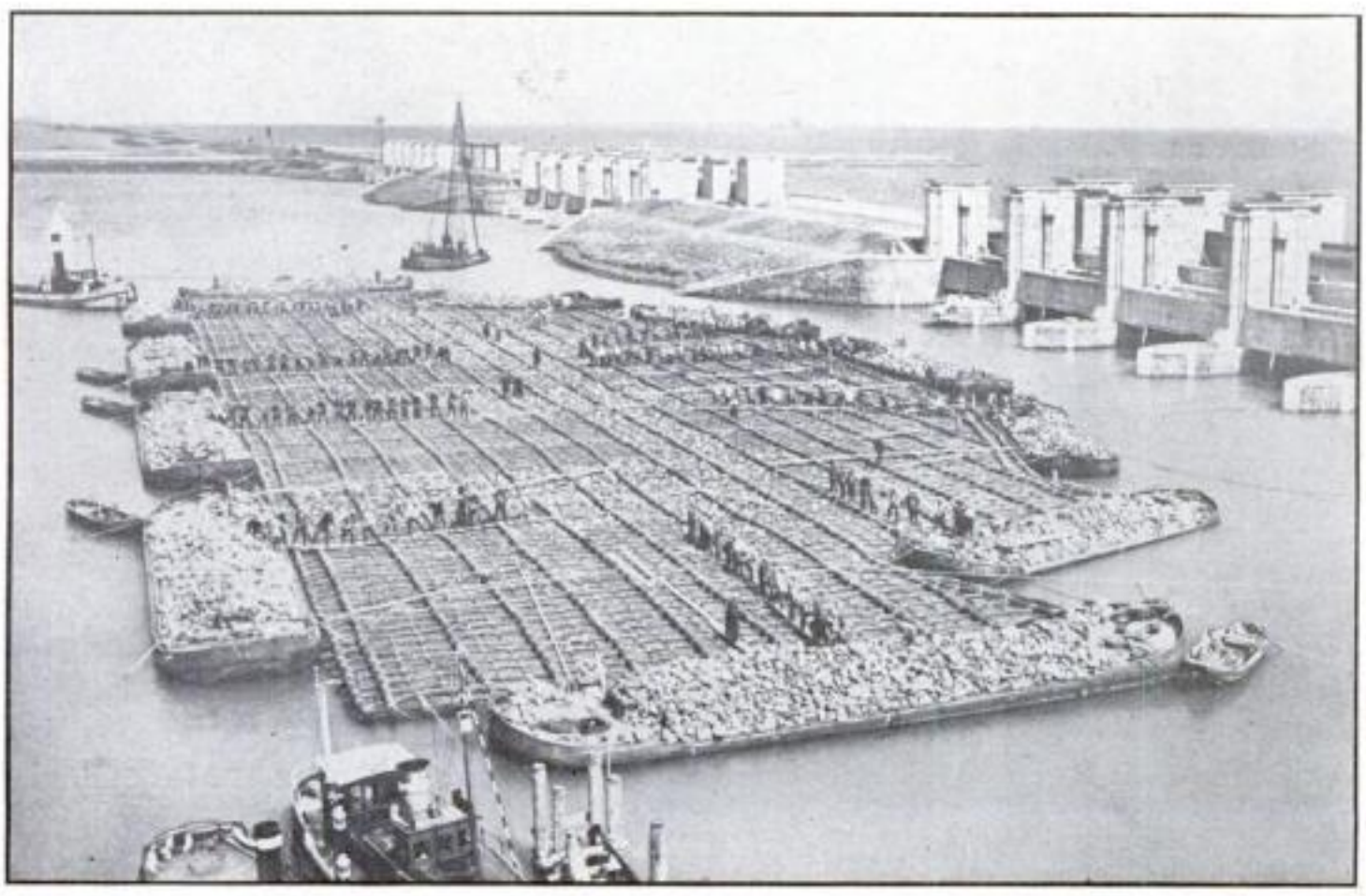
For rough guessing at the hours, a right angle formed with the index fingers of both hands will do for estimating the slant of the clock's hand.

It is quite generally known that the standard time which guides all our daily activities is obtained directly from the stars in a Government Observatory in Washington, D. C., but not many people know that it is possible for anyone to regulate a clock or watch by the stars.

No clock that man has been able to build compares in accuracy with the Great Star Clock of the heavens. Even the superb clocks in an observatory must therefore be checked by watching the times at which certain stars cross the zenith point of the observatory's location.

The astronomer in charge of this work knows that any star will arrive at the zenith point (he calls it the meridian) at three minutes and fifty-six seconds earlier each night. If the observatory clock should say that a star passes the meridian at only three minutes, fifty-five and nine-tenths seconds before the time of its meridian passage on the previous night, then the *(Continued on page 104)*

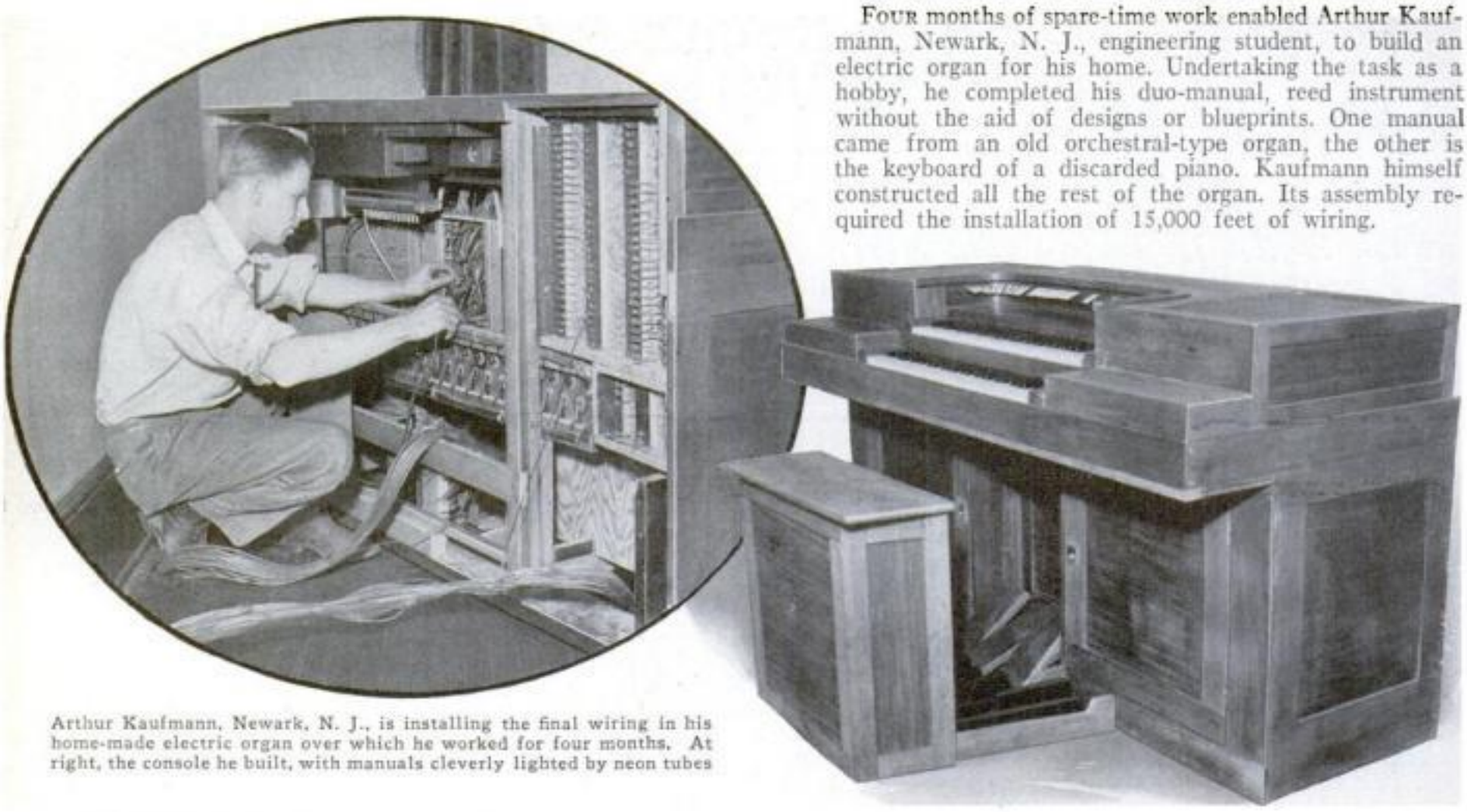
Rafts, Loaded with Rock, Save Holland's Great Dike



WHEN the great dike that Holland has erected to shut off the Zuyder Zee from the North Sea was recently threatened with collapse, big rafts, like the one pictured at the left, were pressed into service to save it. Heavy rainfall had swollen the currents passing through the sluice gates, and scoured out deep holes in the dike's foundation. To plug the holes, huge rafts were floated to the site, loaded with rocks, and sunk. Other unforeseen events have followed the shutting off of the Zuyder Zee. Coincident with the monster engineering project, fishermen declare their catches of flounder greater than ever before, though the reason is not known. German scientists say the dam has caused earthquakes.

Uses Old Parts to Build His Electric Organ

FOUR months of spare-time work enabled Arthur Kaufmann, Newark, N. J., engineering student, to build an electric organ for his home. Undertaking the task as a hobby, he completed his duo-manual, reed instrument without the aid of designs or blueprints. One manual came from an old orchestral-type organ, the other is the keyboard of a discarded piano. Kaufmann himself constructed all the rest of the organ. Its assembly required the installation of 15,000 feet of wiring.



Arthur Kaufmann, Newark, N. J., is installing the final wiring in his home-made electric organ over which he worked for four months. At right, the console he built, with manuals cleverly lighted by neon tubes

PORTABLE BABY HOLDER

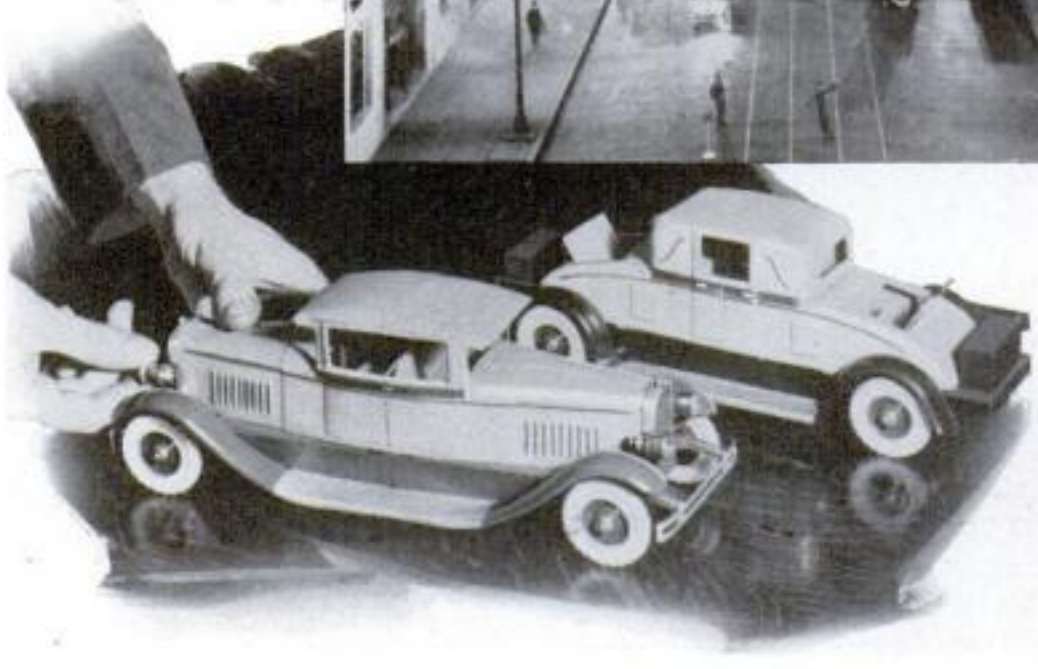
BABY is kept safe and comfortable, at home or on a drive, by the demountable seat illustrated above. Its spring base, a curving bar of strong steel, fits securely in a metal slot, of which any desired number are provided. One may be permanently installed in a car's front compartment and a second in the rear; others may be placed on the porch and in various rooms of the home.

MINE SILVER IN STUDIO

MINING for silver in a Hollywood movie studio has yielded 60,000 troy ounces, valued at $17,000, in six months. The precious silver is recovered electrically from baths that dissolve silver salts during development processes.

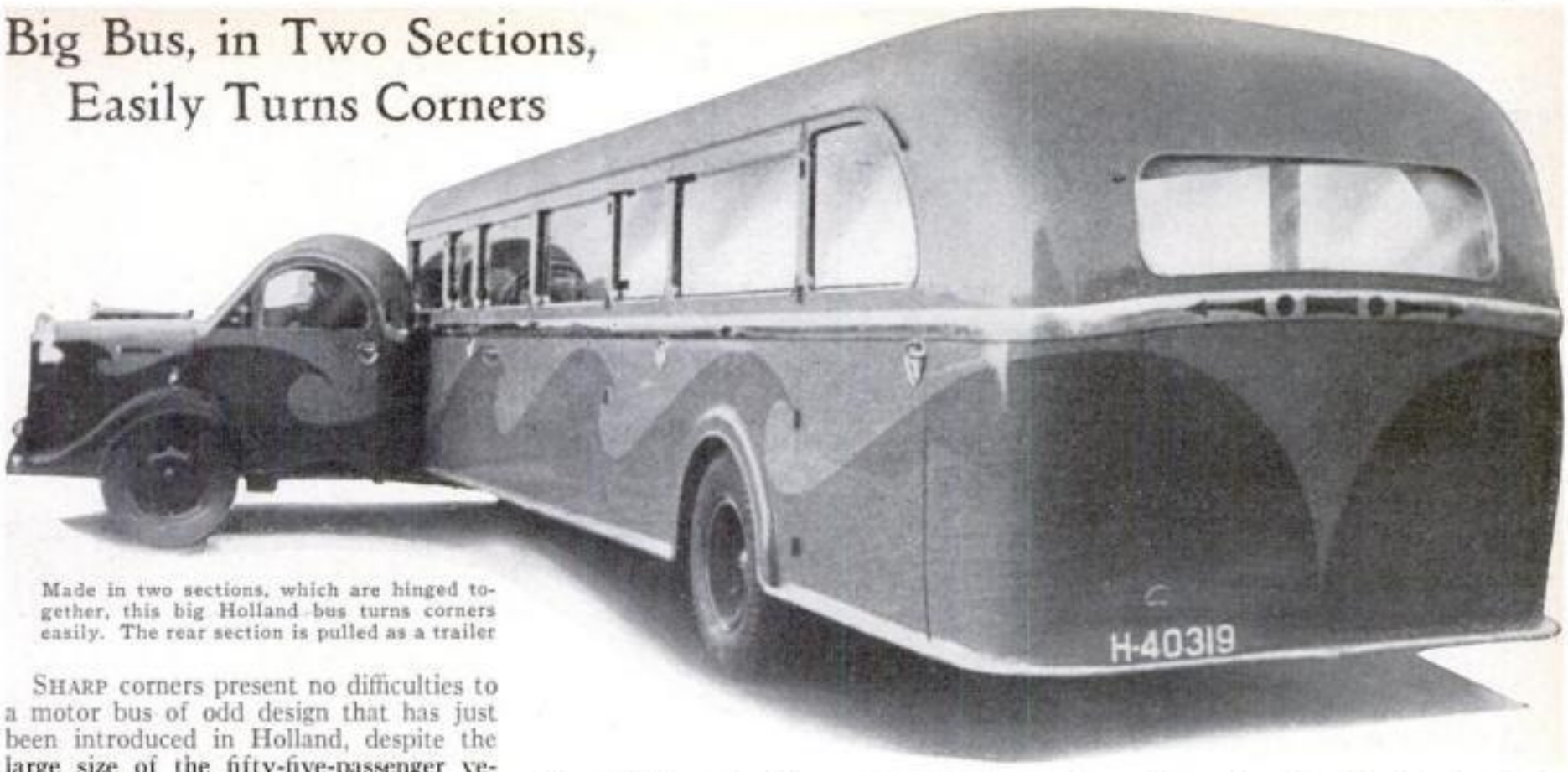
MODEL AUTOS TEST LIGHTING PROBLEM

TINY automobiles, with two front ends or two rear ends, are used in a Cleveland, Ohio, laboratory to help solve street lighting problems. The model street, ten feet long, is made to appear twenty by the clever use of a mirror. Automobiles on the right side of the street have two rear ends, so that the reflected images will correspond to those seen directly. Cars on the left side have two front ends. Half of a street car, placed against the mirror, looks exactly like a whole car.



Model street scene set up in a Cleveland laboratory to test street lighting effects. Left, double-ended model autos used in the unusual experiments

Big Bus, in Two Sections, Easily Turns Corners

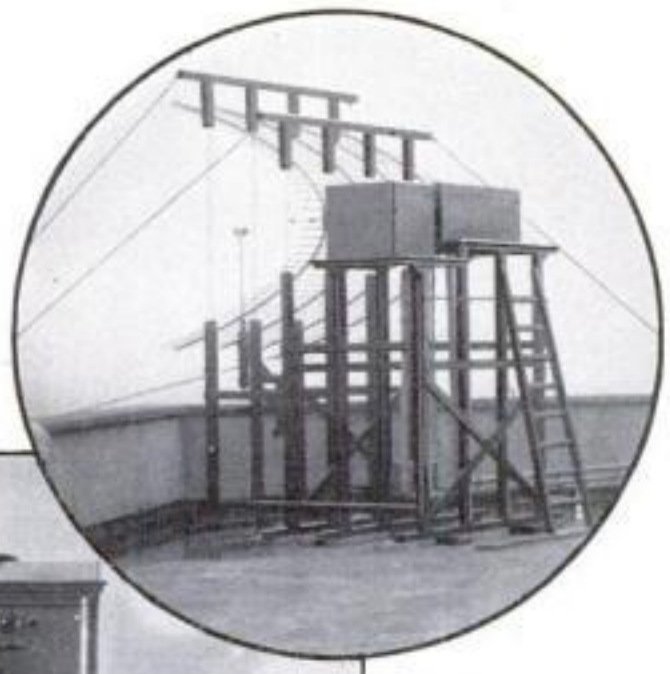


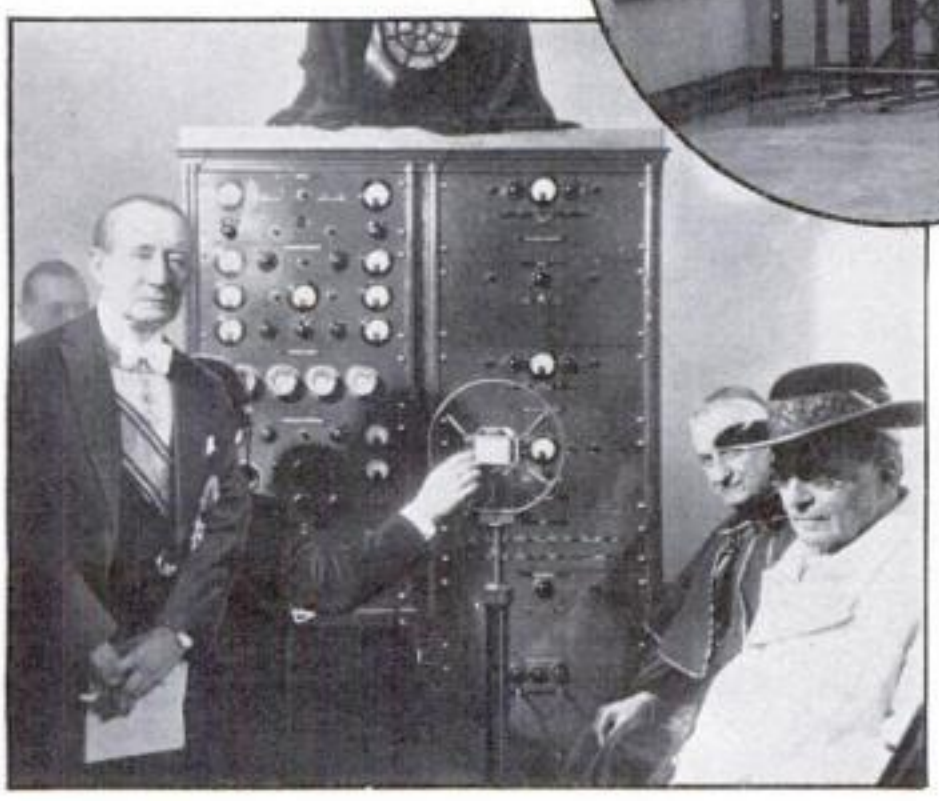
Made in two sections, which are hinged together, this big Holland bus turns corners easily. The rear section is pulled as a trailer

SHARP corners present no difficulties to a motor bus of odd design that has just been introduced in Holland, despite the large size of the fifty-five-passenger vehicle. Its forward end is hinged to the rear, and the two sections pivot in rounding a turn. To a spectator of the remarkable evolution, the bus appears to turn around and look at itself, as seen in the photograph above. Power is transmitted from the engine to the front wheels through a driving mechanism especially designed for the folding bus.

ULTRA-SHORT-WAVE RADIO AT VATICAN

AN ULTRA-SHORT-WAVE radio station has been installed at Vatican City, Italy, for communication between the Vatican and the summer residence of Pope Pius XI at Castel Gandolfo, twenty miles away. The set uses waves only fifty-seven centimeters (about twenty-one inches) in length. According to its noted designer, Gugleilmo Marconi, it represents the "first practical application of microwaves." Marconi has been endeavoring for more than thirty years to harness these waves, which are a minute fraction of the length of those used in ordinary broadcasting. Such waves may be focused directly at the receiving station, like a beam of light, using a parabolic antenna as a mirror. Messages may be transmitted in this way with economy of power and comparative secrecy. Until recently it was supposed that ultra-short waves could not be used for long-distance transmission because they would not follow the curvature of the earth's surface. In a test last year, however, Marconi succeeded in sending a one-way message 167 miles on a twenty-one inch wave.





In the circle is the parabolic antenna on the roof of the summer home of Pope Pius XI. It acts as a mirror, directing the radio waves in a beam

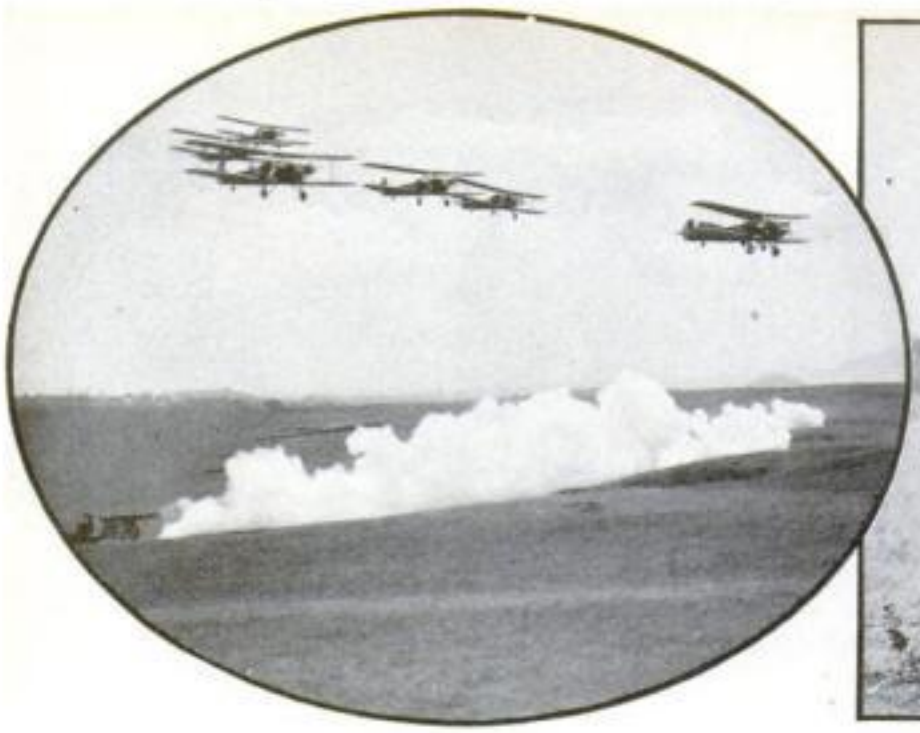
Marconi, left and Pope Pius XI, right, inaugurate the new ultra-short radio system in the Vatican. This is the first practical use of short waves

NEW BEDSIDE LAMP HAS ADJUSTABLE SHADE

ADJUSTABLE openings in the sides and bottom of a new lamp shade, for bedside or sickroom use, regulate the illumination according to the user's wishes. The apertures on each side are uncovered to the desired extent by turning a knob attached to a shutter. Those on the bottom panel may be adjusted similarly, or the panel may be slid out entirely to provide a light of full strength.

UNSALABLE ORANGES NOW MADE INTO GUMDROPS

GUMDROPS from orange trees is the most recent development in the effort of orange growers to make use of all the by-products of their groves. The new gumdrops are made of the fruit pectin, a jelly-like white compound derived from the unsalable oranges. Last year, confectioners purchased fifty thousand dollars worth of pectin from orange growers.



Men and Howitzers Moved in Big Bombing Planes

AN EXPERIMENT first tried two years ago was repeated recently on larger scale when an entire battalion of field artillery was rushed by air across Panama to defend the canal against an imaginary enemy. Men and howitzers boarded ten big bombers (upper right) at Bejuco and were whisked to La Chorrera at 100-mile-an-hour speed. A few minutes after the landing, the guns were set up and in action, while the bombers (upper left) were headed back toward their base.

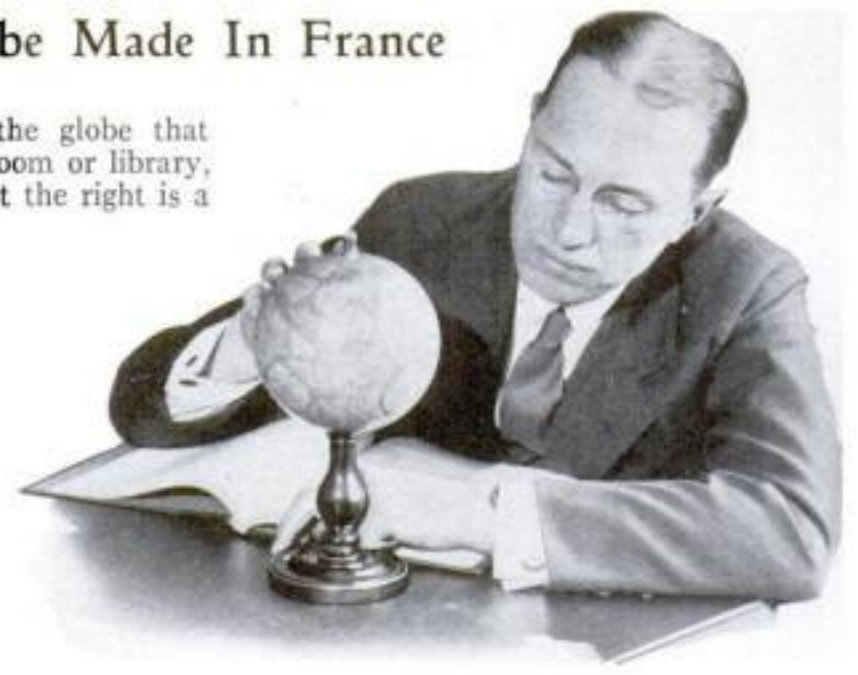
Made in the form of a schoolboy, this sheet steel sign, with warning words, is used in Canton, Ohio, to protect school zones from careless motorists

STEEL FIGURE OF BOY GUARDS SCHOOL ZONE

MOTORISTS passing through the school zones of Canton, O., are reminded to watch out for the safety of children by arresting signs placed in the center of the highways. Each of the unusual signals represents the figure of a schoolboy with upraised hand, and is conspicuously painted in black and orange. One of these sheet-steel signs on its iron base is placed a block and a half away on each side of the school, where it provides an effective warning to careless drivers.

Martian Globe Made In France

THOUGH it resembles the globe that might be seen in a schoolroom or library, the sphere in the picture at the right is a real curiosity—for it represents the surface of the planet Mars as accurately as astronomers have been able to map our neighbor planet. The Martian globe was recently brought to this country from France for the Franklin Institute of Philadelphia, Pa. Lines on its surface show the mysterious canals of Mars, once believed to be artificial but now thought natural markings.



As nearly accurate as present information permits, this globe, made in France, shows the surface conditions of planet Mars

MAGIC LANTERN HAS POWERFUL LIGHTS

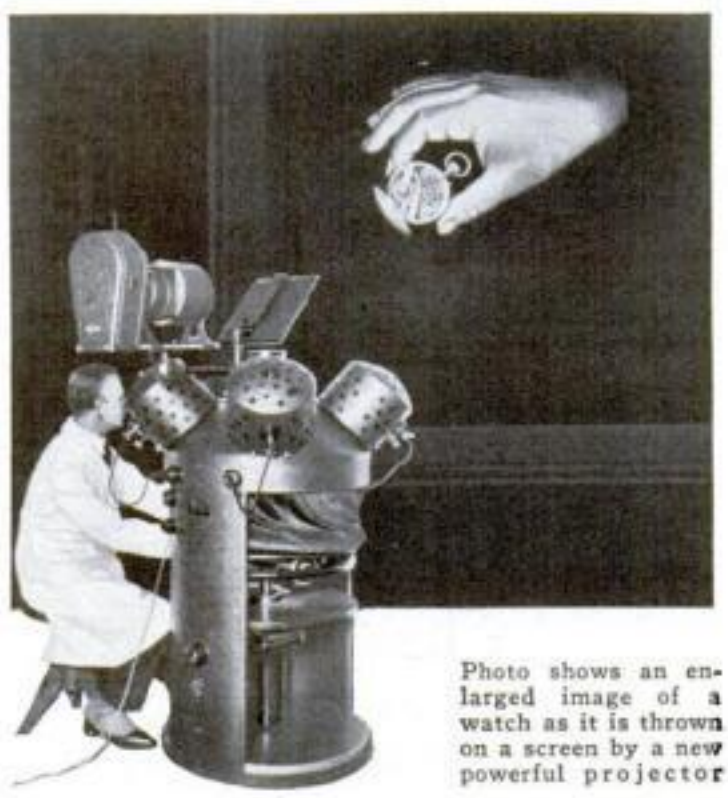


Photo shows an enlarged image of a watch as it is thrown on a screen by a new powerful projector

SHAPED like a warm-air furnace, a powerful projector has been designed by a German firm for throwing enlarged images of opaque objects on a screen. It is especially suitable for use in schools, colleges, and lecture halls. It requires little floor space and is so designed that it does not obstruct the view of those near it. Light is provided by four 500-watt electric bulbs. An ingenious water-cooling system prevents overheating of the objects displayed. So great is the light-transmitting power of the projection lenses that pictures and type on white paper, such as a page of this magazine, may be projected clearly in a room only partially darkened. An attachment permits the exhibition of transparent slides and well lighted color photographs.

FOLDING BOAT EASILY CARRIED

This boat, big enough for three, folds flat so it can be carried on car's running board as is shown in photo at upper right

CAMPERS may lift from the running board of their car a small package, hoist it to their shoulders, open it like a book, and slide it into the water. It is a new small boat that folds flat for transportation. While one person may carry it, the boat will accommodate three people. No special carrying equipment is needed. After folding the sides down, the center and tail pieces slip into slots.

ANTI-ROLLING BRAKE HOLDS CAR

AN ANTI-ROLLING brake, devised by an Elgin, Ill., inventor, aids motorists in parking on a hill or in starting a car on an upgrade. Equipped with this device, a car cannot slide backward when the regular brakes are released. An automatic control running from the transmission to the anti-rolling brake automatically throws the latter out of operation when the car is put in reverse gear. The secret of the device is a brake shoe that locks against the drum.

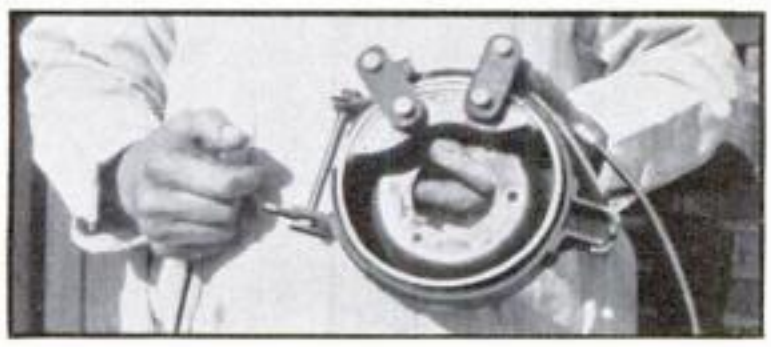


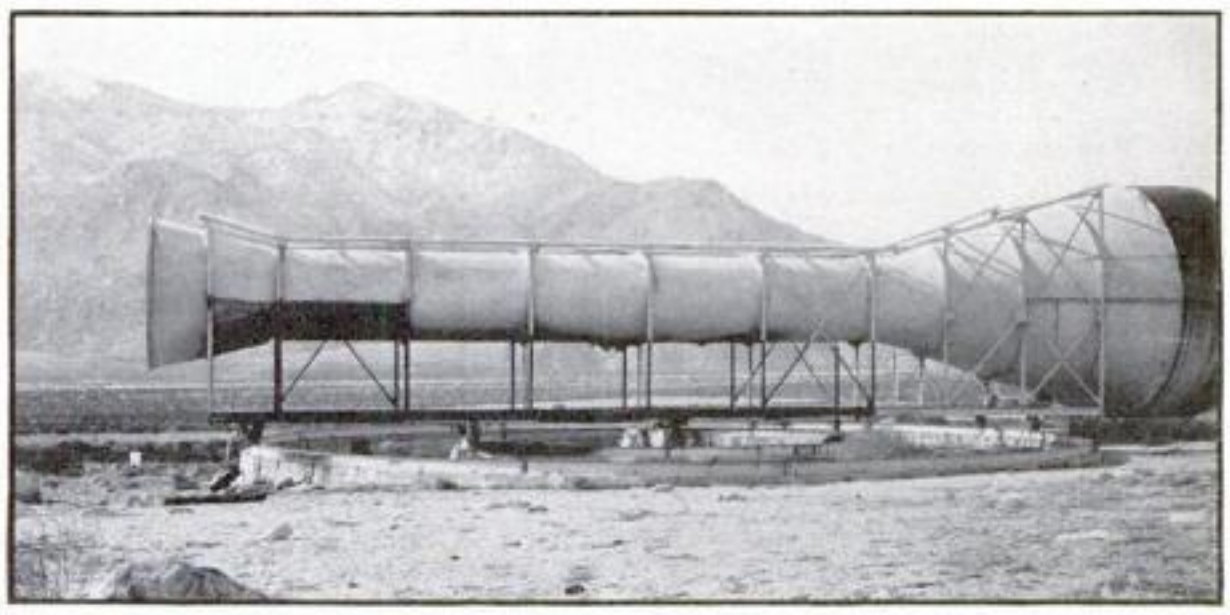
Diagram explains the principle of the anti-rolling brake which is seen in photo at left. The brake holds car on a hillside

INK PAD NEVER DRY

USERS of rubber stamps will hail the appearance of a new stamp pad that never goes dry. An ink reservoir, replenished through the filler tube visible in the photograph above, keeps the surface supplied.

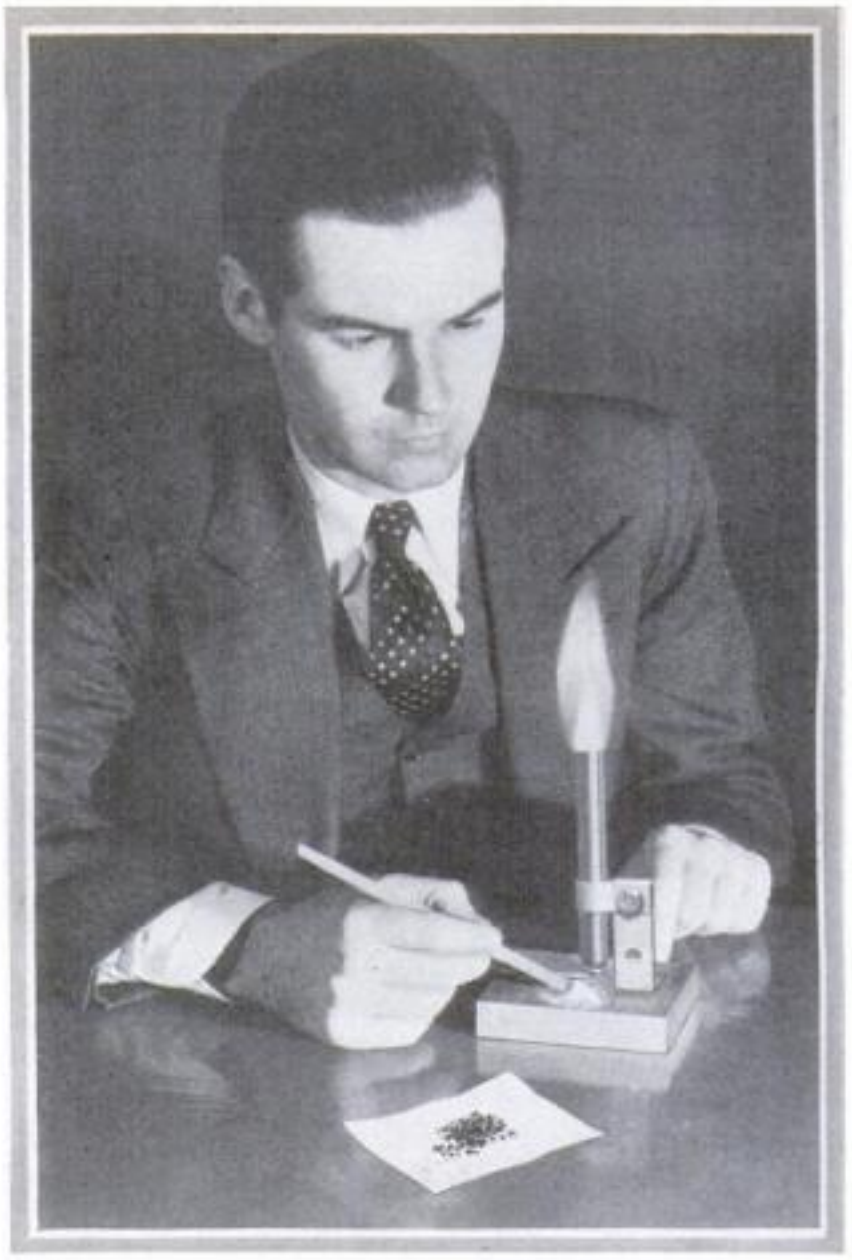
WIND POWER TUBE NOW IS DESERT MONUMENT

WHILE harnessing the wind for power continues to be a favorite project of inventors, few realize such a scheme once actually reached the point of construction on a windy desert in southern California. An abandoned steel tube, sixty feet long and four feet in diameter, still stands on a circular track—a monument to an inventor's dream of cheap power. Propellers within the tube were coupled to a dynamo at the small end. Tests were disappointing; the maximum output, it is reported, scarcely exceeded half a horsepower.



On a windswept desert in Southern California, an attempt was made to harness the wind for power. This abandoned steel tube is all that is left of the project which failed to work

TESTS *You Can Make with* LIGHT and Chemicals



If washing soda is dusted about the air intake of a Bunsen burner, as is shown at right, blue copper sulphate crystals will appear black, due to the change in the color of the flame produced by the washing soda dust

WHEN you snap the shutter of your camera, you perform a chemical experiment. A sensitive chemical on the film is decomposed by the light that streaks through the opened shutter.

Like heat, light causes many substances to change and on this fact hinges the study of photochemistry.

Red mercuric oxide, for instance, is a common light-sensitive chemical and the amateur can demonstrate this fact by dissolving a small amount of it in a few drops of water and an equal quantity of glue. By spreading or brushing the resulting solution on the clean surface of a white piece of cardboard, a simple light-sensitive film can be made.

Unexposed, the card has a light pink color but as soon as light is allowed to strike its surface, the sensitive film turns to a dark brown. The light causes the mercuric oxide to decompose.

With a film of this type, the experimenter can make copies of stencils or other opaque designs by placing the original on top of the sensitized surface and exposing it to the sun. The uncovered portions of the card will turn brown while the areas protected by the design will remain pink.

Another inexpensive light-sensitive mixture can be made from potassium dichromate (often referred to as potassium bichromate) and glue or gelatin. Differing from the preceding experiment with the mercuric oxide, the chemical in this mixture changes the solubility of the glue when it is exposed to the light.

Glue, as we know, can be redissolved in water after it has hardened. However, if potassium dichromate is added to it and the solution is allowed to dry under a light, it can not be redissolved.

By making use of this odd property, the home chemist can perform an interesting experiment. Dissolve a pinch or two of powdered potassium dichromate in about one-sixteenth of a glass of water (one-half ounce) and stir in a half teaspoonful of liquid glue or household gelatin that has been soaked in water. When this has been mixed, add a small amount of lampblack or charcoal and brush the solution on the clean surface of a white card. After it has dried, cover the coating with an opaque stencil or other design and expose it to the light.

After several days of exposure, place the card in water. The portions of the card covered by the stencil and unexposed to the light will wash off while the exposed areas will remain to form a perfect image. The portions exposed to the light are no longer soluble in water.

From inexpensive chemicals, the home experimenter also can make his own sensitized blueprint paper. The two chemicals needed are iron (ferric) ammonium citrate and potassium ferricyanide (not ferrocyanide). Place about an inch of the ferric ammonium citrate in a test tube six inches long and three-quarters of an inch in diameter, and fill the tube with water. In a second tube, place half an inch of the potassium ferricyanide and fill it with water. In a dark room, shake both tubes to dissolve the chemicals and then mix the two solutions.

THE paper to be sensitized can be coated with a brush or it can be immersed directly in the solution. An excellent coating brush can be made by binding some strips of cotton cloth to the end of a glass microscope slide. After thoroughly coating the paper, hang it up to dry in a dark room. Incidentally, sensitized papers should, of course, be kept in the dark until they are ready for exposure.

To make a blueprint with your home-made paper, place the prepared sheet on a glass plate and cover it with the design to be copied which is generally a transparent tracing made in black ink. Be sure to place the tracing in contact with the sensitized side of the paper. Then cover the tracing with another glass plate and expose it, sensitized face up, to the light. One minute under an arc lamp, or several minutes under the sun, should be sufficient for this exposure.

WHEN the exposure has been completed, take your improvised printing frame into a dark room and remove the paper. A copy of the design or tracing will be plainly visible. Wash out the remaining chemicals on the surface and allow the sheet to dry. The finished blueprint will be an exact copy in white lines on a blue background.

The process of blueprinting is entirely chemical. The light reduces or changes the ferric ammonium citrate into another iron salt which reacts with the potassium ferricyanide to form Prussian blue. This reaction, of course, does not take place where the paper is covered and the unexposed surfaces remain white.

This same reaction can be used by the amateur chemist as the basis of a mystifying trick. A white sheet of paper is first prepared by immersing it in iron (ferrous) sulphate solution and allowing it to dry. To all outward appearance it is still an ordinary piece of white paper. However, when the magician writes on it with a steel pen dipped into a solution of potassium ferricyanide, which looks like water, the lines appear as a deep blue. This trick is often referred to as writing with water.

Prints of tracings and other similar opaque designs also can be made in tones of orange and brown instead of in blues and whites. In this case, the paper

Thrilling and Practical Experiments for the Home Laboratory Are Described in Detail in This Informative Article

By **RAYMOND B. WAILES**

PUTTING DESIGNS ON BLUEPRINT PAPER

When lace, tracings, or other designs are exposed to the light, as shown above, they are printed on light-sensitive paper as seen in the square at upper right. At right, a microscope slide is used to coat paper for blueprint paper

is first immersed in copper sulphate solution and dried. Then it is placed in a solution of potassium dichromate and again allowed to dry.

After exposure, the image is brought out or developed by immersing the sheet in a solution of silver nitrate. Silver nitrate is expensive, so economize by dissolving only a few crystals at a time. If desired, the silver nitrate can be brushed on.

As the image develops, it will appear in orange tones instead of the usual blue. After developing, wash the print in water. Be careful, however, as the image will have a tendency to fade if the washing process is unduly prolonged.

ALTHOUGH the manufacture of photographic film requires chemicals and skill beyond the means of the average home chemist, the experimenter can study the photochemical effects with silver compounds by preparing some silver chloride and exposing it to the light.

Dissolve a few crystals of silver nitrate in water and add some ordinary salt solution. Silver chloride will be formed as a curdy, white precipitate that will settle and turn to a bluish-gray when the light strikes it.

Sufficient silver nitrate for this experiment can be obtained by scraping the emulsion from several old photograph negatives and dissolving it in warm nitric acid. The liquid obtained after filtering will contain silver nitrate and can be used in place of the pure solution.

By making use of these light-sensitive properties, you can make an attractive copy of your favorite photograph on the polished surface of a copper plate. Clean the sheet of copper thoroughly with emery cloth and then immerse it in a solution of copper (cupric) chloride of moderate strength. A coating of white cuprous chloride will be formed on the metal surface.

After the copper sheet has dried, place the photographic negative over the sensitized coating and expose it to an arc lamp for about one minute. If any ordinary lamp of high wattage is used a longer exposure will be necessary. Best results will be obtained if several experiments are made with a small piece of copper to ascertain just the right length of exposure.

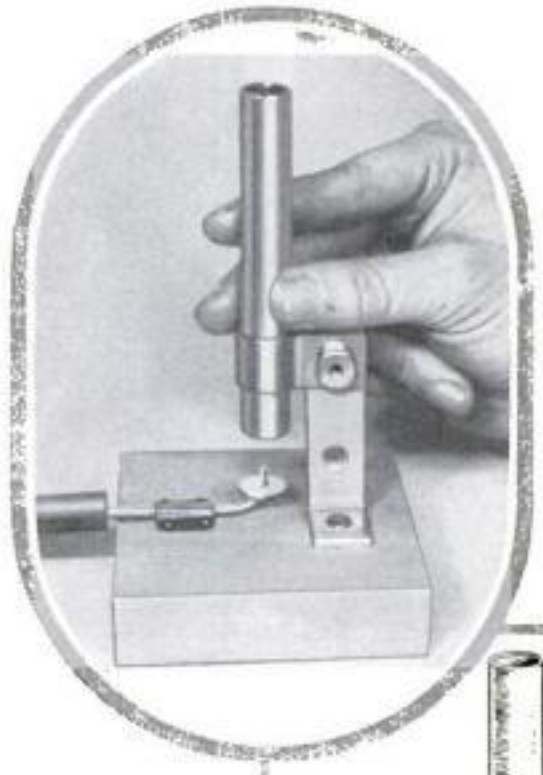
Remove the negative in a darkened room and place the copper sheet in a bath of ordinary salt water. An artistic print of the negative will appear. Allow the sheet to dry and then give it a thin coating of varnish to prevent the metal from tarnishing. If desired, a sheet of brass can be used in place of the copper.

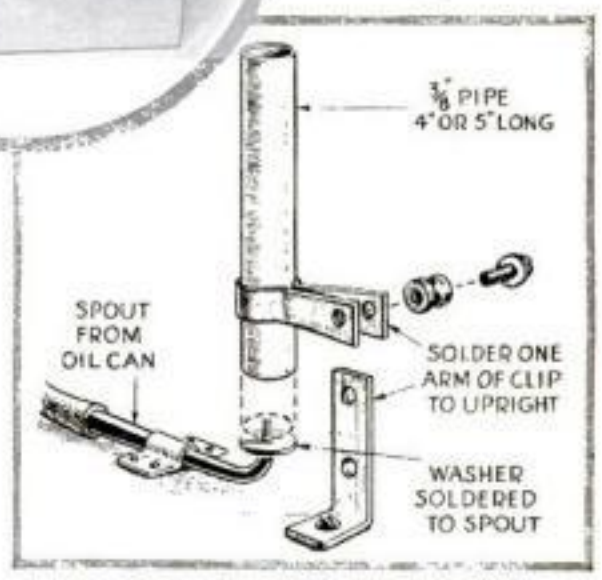
Many interesting experiments with light can be performed with the homemade gas burner shown in the illustrations. Besides serving as apparatus for these experiments, the burner also will be a valuable addition to your regular laboratory equipment and you should, therefore, make it.

THE stack of the burner is a short length of iron pipe having an inside diameter of three-eighths inch. The gas jet is the spout of an old oil can bent to the shape shown. The washer, soldered in place just below the tip, serves as a seat for the bottom of the stack. The stack is supported by an adjustable clamp made from a piece of metal and fastened to the top of a small shelf bracket with a nut and bolt. A small block of wood forms the base.

To obtain the best flame, the opening between the bottom of the stack and the jet should be altered so that just the right amount of air is drawn up and mixed with the gas. Too much air will cause the flame to roar while lack of air will give a wavy yellow flame. The best flame has two sharply defined blue cones and also it will neither roar nor wave.

A burner of this type can be made to give an excellent monochromatic (one color) flame. Sodium chemicals, such as sodium bicarbonate or washing soda sprinkled around the base of the jet will be drawn up into the stack and color the flame a bright yellow. This is caused, we know, by the presence of sodium in the washing soda.





HOMEMADE BUNSEN BURNER

All the material needed to make a Bunsen burner is shown in the drawing. When ready for use, it will look like the burner in photo

Odd Figures

You Can Form with Your Hands

AMUSING figures, grotesquely resembling human beings, may be made with the fingers and a few simple accessories such as a tuft of cotton, eyes from a discarded doll, and a streak or two of paint. The six poses illustrated here were created by Otto Croy, German artist. With a little ingenuity, almost unlimited variations may easily be devised.

Folding the fingers into a loose fist and covering them with a scarf, while a doll's eyes are set between the two joints, will enable you to create this striking Grandma

A shoe button for an eye and a flowing headdress give this queer looking actress

The thumb protrudes from between two folded fingers to support eyeglasses in producing this man with a bad cold. Hat and muffler complete the illusion

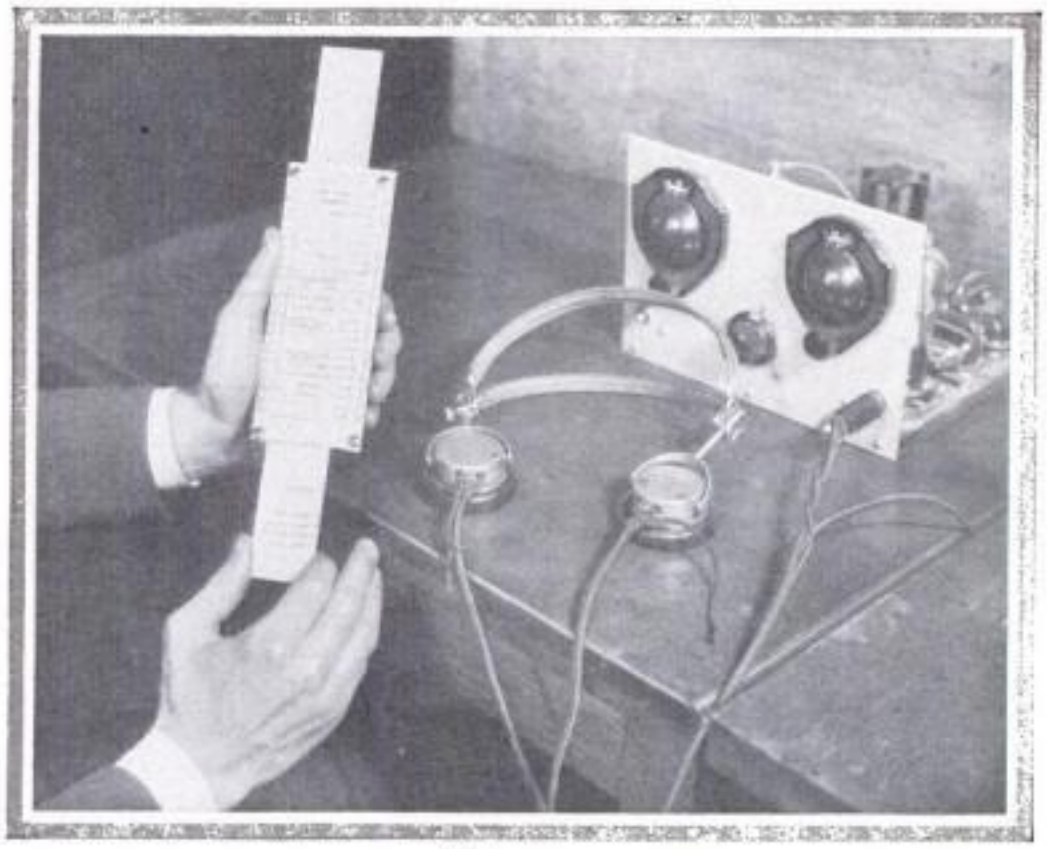
Black wool forms the hair and beads the eyes of this rather dour-faced creation called a "radical"

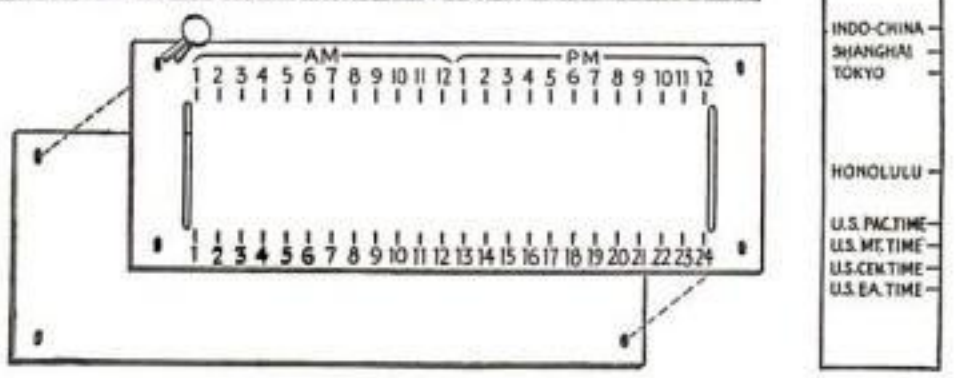
With buttons for eyes and wool or cotton combed out for a beard, you can bend your fingers so as to suggest this Santa Claus whose pack is formed by the thumb and raised finger at left

It is only necessary to put on the back of your hand lines suggesting a human face, add stripes to the fingers to indicate the trunks to have the grotesque swimmer at the left

EASILY MADE CARDBOARD

Scale Is World Time Table *for* DX Fans





With this scale the distance fan can convert time at any section of the globe to local time. Diagram, right, shows how the scale is made

DISTANCE fans and short wave enthusiasts will find the simple time converter illustrated above a convenient companion to their log book and list of stations. It replaces complicated time tables and gives the converted time for any part of the globe.

The converter, which resembles a slide rule, consists of two scales made from stiff white cardboard or Bristol board. The small scale is movable and slides in slits placed at each end of the larger scale. For stiffness, a third piece of cardboard can be fastened to the back of the large scale with brass paper fasteners.

The larger scale has two sets of twenty-four equally-spaced divisions, one set above and the other below the space occupied by the sliding scale. The upper divisions are numbered from one to twelve in two steps (1, 2, 3, ... 12, 1, 2, 3, ... 12) while the lower divisions are numbered from one to twenty-four consecutively. This lower scale represents Greenwich time.

As shown, the sliding scale bears the names of the principal countries and sections of the globe arranged according to the spacing of the divisions on the large scale. If desired, the converter can be completed by adding the names of smaller nations in their proper locations.

To use the time slide rule, it is necessary only to set the movable scale so the scheduled time for the broadcast or transfer of messages appears opposite the name of the country in which the station is located. The converted time then appears opposite the names of the other localities on the sliding scale. Since time differences exist only between points located on different meridans (there being a difference of one hour between every fifteen degrees) any two cities on the same north and south line will be on the same time.

The United States, for instance, is cut by four of the fifteen-degree divisions, giving Eastern, Central, Mountain, and Pacific Time. If it is desired to know the time in Baltimore, Md., when it is 8 p.m. in London, set the scale so the word "England" appears opposite the 8 p.m. division on the large scale. Since Baltimore is an Eastern city, the converted time (3 p. m.) will appear opposite "Eastern Time." With the same setting of the rule, it will be found that it is 2 p. m. in Chicago (Central Time), 1 p.m. in Denver (Mountain Time), and 12 noon in Los Angeles (Pacific Time).

It must be remembered, however, that the theoretical change of date in the world takes place in the Pacific ocean just East of the Hawaiian Islands. In other words, when it is 10:30 p.m. in Honolulu on May fifteenth, we find that the scale shows 4 p.m. in Indo-China. However, since the change of date takes place just east of Honolulu, it will be 4 p.m. the next day (May sixteenth in Indo-China). Always read down when going from West to East, and up when going East to West.

Although the original scale was made relatively large for convenience, the ingenious reader will find he can make a converter on a smaller scale.

Making Coil Spring Binding Posts

BINDING posts made in the form of coil springs are great time savers for the radio experimenter who frequently changes connections. Pushing the spring to one side, opens the coils to receive one wire or several. When the spring returns, the coils grip the wires tightly.

Any tightly coiled spring can be used or the amateur can make his own from brass spring wire. To wind the coil, fasten a large nail in a lathe, drill press, or hand drill chuck. Push the end of the wire into one of the spaces between the chuck jaws and turn the chuck by hand, winding the wire around the nail. Three-eighths or one-half inch lengths clipped from the coil form the binding posts.

To fasten the spring posts in place, bend a loop in one end of the wire that forms the coil, making it small enough to take a screw.—W. B.

Coil spring binding posts will save the experimenter time when wiring trial circuits

MANY Measurements *with* ONE ELECTRIC METER

By JOHN CARR

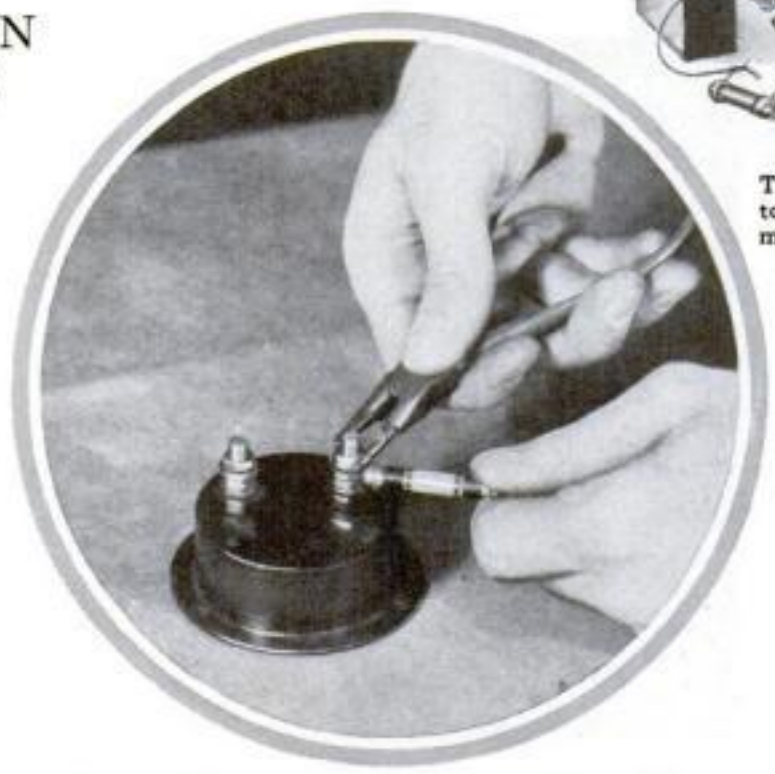
The meter equipment in the home radio laboratory need not be large. Countless tests and measurements can be made with a single meter

THROUGH the use of resistances and shunts, you can increase the usefulness of your assortment of meters.

Almost every amateur experimenter and set builder has at least a milliammeter. With this one instrument, you can make measurements of voltages as well as amperages. To change a milliammeter for voltages readings, it is necessary only to connect it in series with a suitable resistance. As an example, a milliammeter with a 0 to 1 scale connected in series with a 1,000 ohm resistor will make voltage measurements from 0 to 1. If a 10,000 ohm resistor is connected in series with the meter, it will allow measurements from 0 to 10 volts and a 100,000 ohm resistor will increase the range to 0 to 100 volts.

In a similar way, the amateur can arrange his voltmeter so as to increase the limit of its scale. This is done by connecting the meter in series with a suitable resistor. To find the value of the resistance in ohms, divide the difference between the maximum scale reading desired and the actual maximum by the actual maximum and multiply the result by the resistance of the meter.

Of course, with such a multiplier in series with a meter, it will be necessary to multiply the reading of the pointer on the scale by a conversion factor to obtain the actual voltage across the terminals. This factor will be equal to the new maximum reading divided by the original maximum reading of the scale.



By connecting a resistance in series with a milliammeter you can use it over various voltage ranges

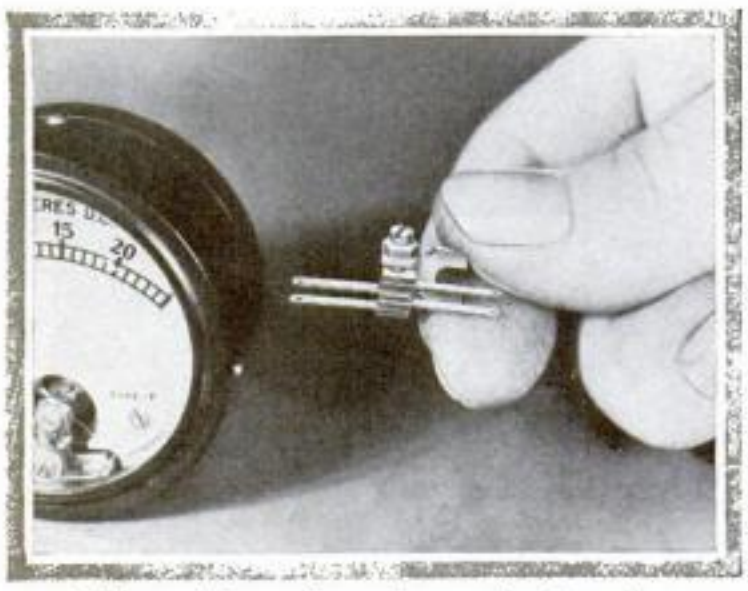
For instance, if a resistance is being used to increase the actual maximum scale reading of 10 to a desired maximum reading of 20 and the pointer rests at 8, the actual voltage will be 8 multiplied by 20 divided by 10 which is 16.

The range of an ammeter can be increased by connecting a suitable resistance across its terminals in the manner of a shunt. To find the proper resistance value in this case, multiply the internal resistance of the ammeter by the actual maximum reading of the scale and divide the result by the difference between the desired maximum scale reading and the actual maximum scale reading.

A factor, of course, must be used to convert the readings on the scale to the new range. As in the case of the voltmeter, this factor is obtained by dividing the new maximum scale reading by the actual maximum scale reading.

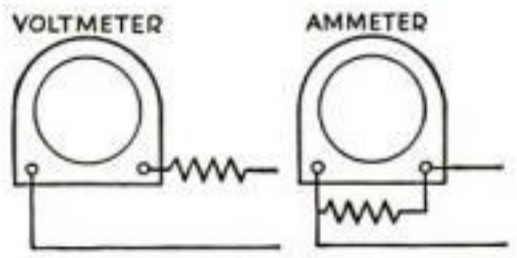
Small alternating current readings also can be made with direct current meters if a small copper oxide rectifier, such as shown, is connected in shunt across the meter binding posts. Being especially designed to rectify meter current, the device measures less than one inch square and can be connected permanently in a confined space. With one of these rectifiers accurate A. C. measurements can be made.

A voltmeter also can be used for making fairly accurate measurements of resistances. The unknown resistance is connected in series with a known resistance and to a battery. Voltmeter readings are then made across each resistance. The value of the unknown resistance will be equal to the value of the known resistance in ohms multiplied by the reading of the voltmeter when it was connected across the unknown resistance divided by the voltmeter reading when it was connected across the known resistance.



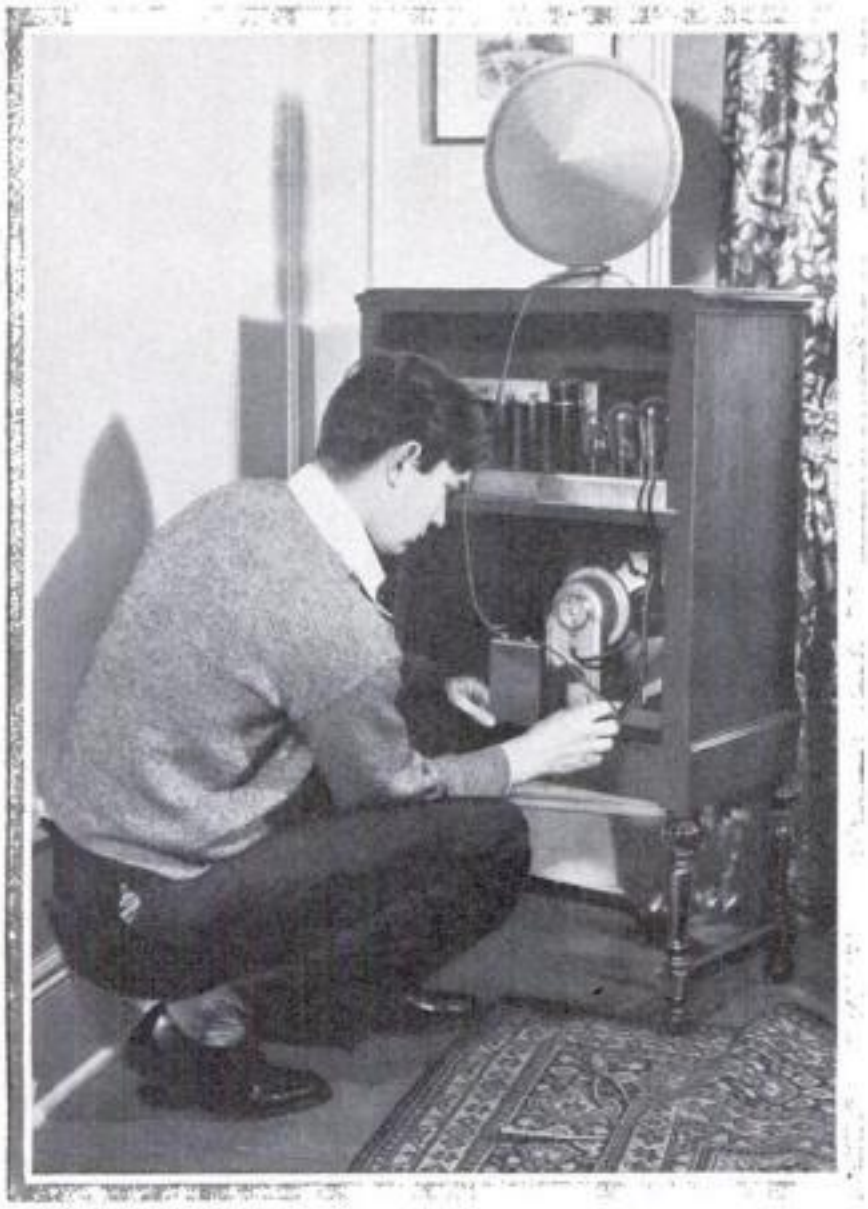
This rectifier can be used to make alternating current measurements with direct current meter

A resistance shunted across the terminals of an ammeter will increase its scale range

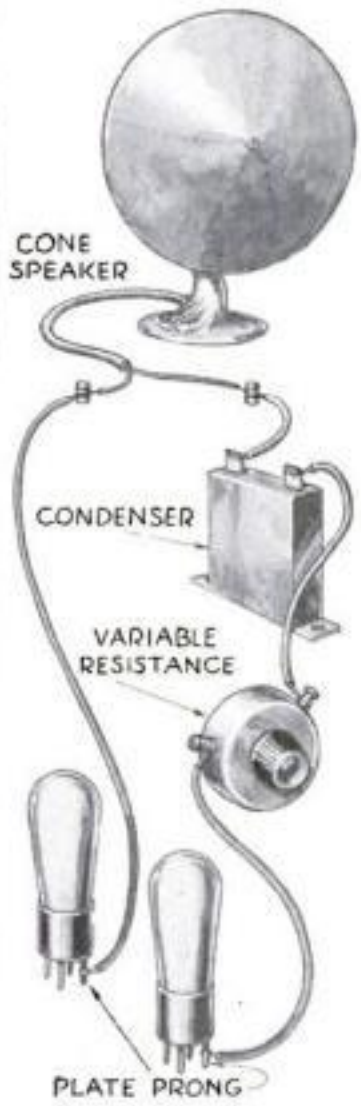


How to wire resistances to increase range

Second Speaker Adds Tones *to your* RADIO



An experimental dual speaker arrangement being tested in the home. The regular loudspeaker, supplied with a commercial receiver, was supplemented by a cone speaker which was hooked in according to connections shown in drawing at right



ALTHOUGH modern radio design presents nothing that is startlingly new, there is one development of special interest to the radio experimenter and set builder.

A few years ago, the dynamic loudspeaker replaced the older cone type because it was capable of handling greater power and a wider range of frequencies with increased fidelity. Now dual speakers and single speakers of a refined design are being used to take care of even greater power and extend the reproduction range.

The title, "dual speakers," however, is used at present to identify either of two distinctly different systems. In one, two speakers, similar in construction but having slightly different peaks, are connected in parallel to the output transformer of the receiver. These speakers operate more or less as one to give a fullness, roundness, and perspective of tone that would be difficult to obtain with a single unit of ordinary design.

In the second system, two speakers also are used, but each unit is designed and connected to cover a separate portion of the entire frequency range. One speaker reproduces the high frequencies while the other brings out the lows.

With extended range dual speaker arrangements, the requirements placed on each unit are reduced and the two speakers can operate with relatively distortionless fidelity from the low bass notes of the bassoon to the high-pitched shrills of the piccolo.

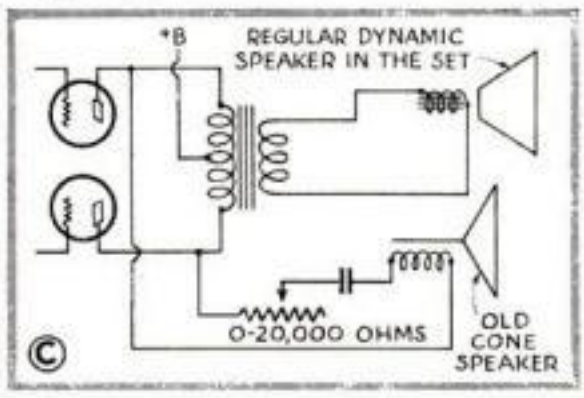


Diagram shows how a cone speaker can be connected up to supplement dynamic speaker

To the amateur set builder, extended range loudspeaker equipment opens an interesting field of experimentation.

The particular extended range system shown at A in the drawings was designed by the Bell Telephone Laboratories and was used in connection with a special high frequency speaker developed to operate on frequencies from 3,000 to 12,000 cycles. A second speaker to cover the range up to approximately 3,000 cycles was connected to the low-frequency side of the carefully designed filter arrangement.

Each filter delivered to each speaker only those frequencies that corresponded to its range. When operating, each speaker reproduced the tones in its range independent of the other.

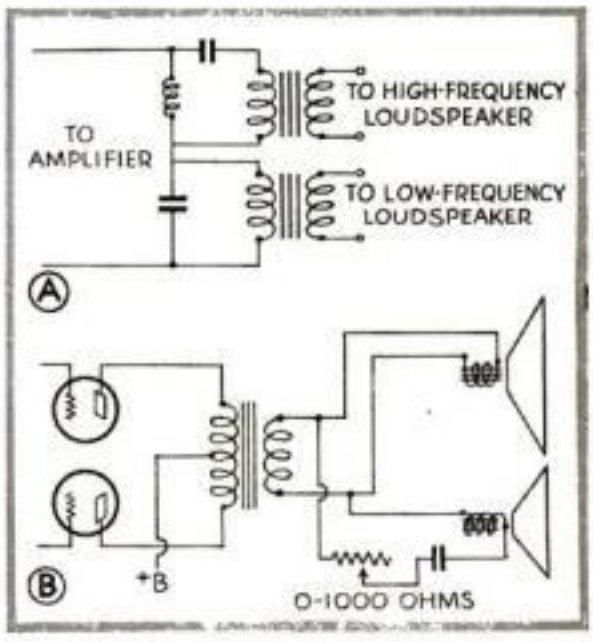
There are, however, two simpler systems that are well within the range of the amateur's skill and his supply of equipment. These are shown in drawings B, below, and C in the second column.

The fact that most old speakers of the cone type are particularly good on the high frequencies forms the basis of the connections shown in C. Almost every amateur has a cone speaker lying around and he can put it to good use accentuating the higher tones that may be lacking in his loudspeaker.

The arrangement shown can be used without altering any of the connections to the loudspeaker that is already installed. Two wires are connected to the plate prongs of the two output tubes and these lead to the cone speaker terminals which are connected in series with a 0 to 20,000 ohm variable resistor and a fixed condenser. The capacity of the condenser may be anything from one-tenth to one microfarad. Try several, and use the one that gives the best results.

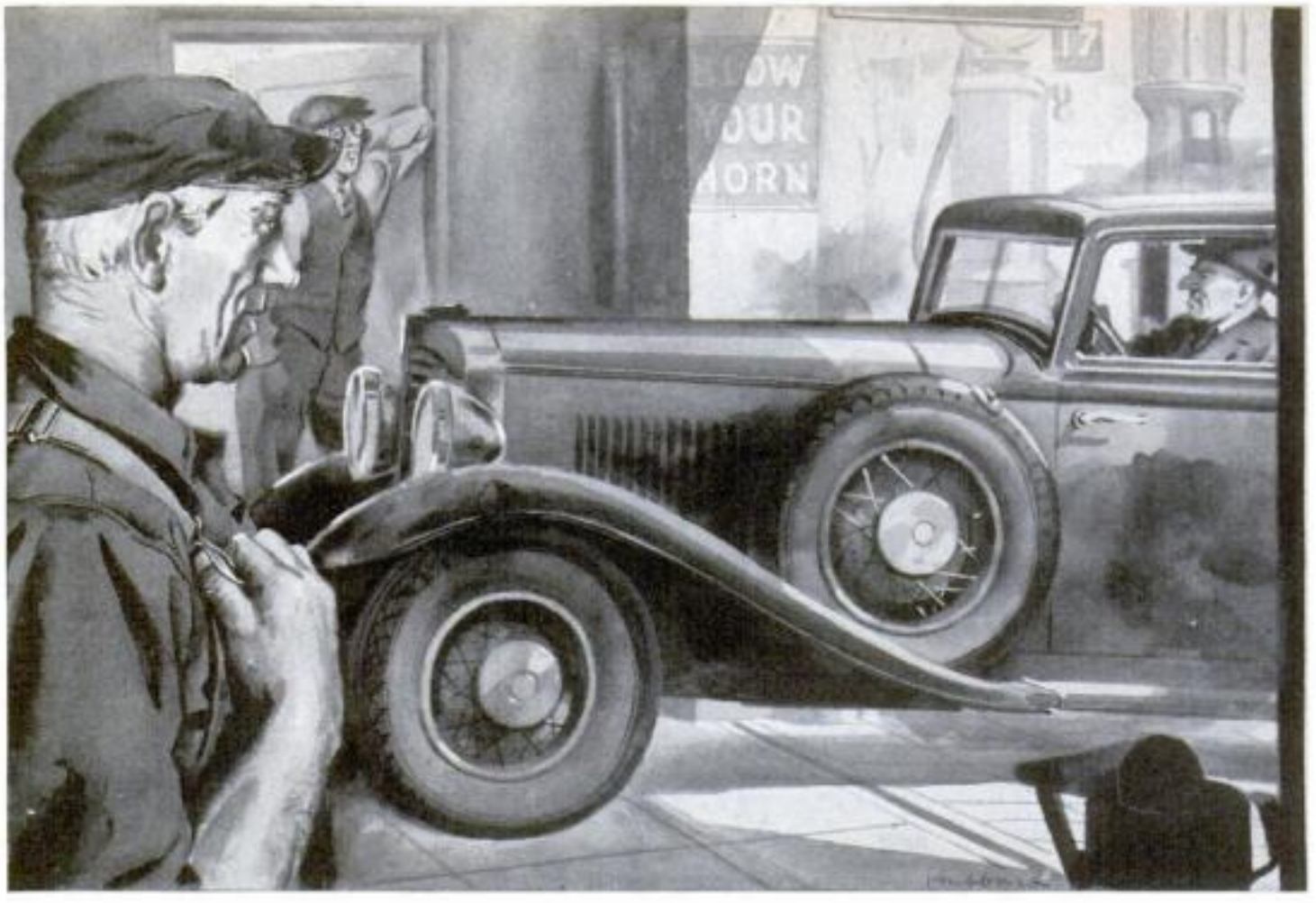
If two dynamic speakers are available, one being designed for high frequency reproduction, the system shown in B can be used. The high-frequency speaker is connected in parallel with the regular speaker and a variable resistor and a fixed condenser, having a capacity that may range from one to ten microfarads depending on conditions, is inserted into one of the leads. To simplify the drawings, the 110 volt power connections for the field are not shown.

Both of these systems depend on the filtering ability of a condenser. A condenser, as we know, tends to pass the higher frequencies more easily than it does the lower ones.



Upper diagram shows how to operate low and high frequency speakers. The other shows how dynamic speaker is hooked into set

"Something wrong?" Gus Wilson asked as he walked toward Chet Harmon's car. "I'll say something's wrong," Harmon grumbled. "The carburetor's on the blink again. This blamed car won't even pull over an ant hill without groaning"



Longer Life *for* Car Valves

BY MARTIN BUNN

CHET HARMON coaxed his car into the Model Garage. Sputtering and coughing, it gave one last asthmatic wheeze as it reached the center of the repair shop.

"Something wrong, Chet?" Gus Wilson grinned.

"I'll say something's wrong," Harmon grumbled. "The carburetor's on the blink again. This blame car's getting worse and worse. Won't even pull over an ant hill now without groaning."

Gus lifted the motor hood. "Why pick on the carburetor?" he inquired after a brief inspection. "Maybe it's something else this time. Start her up and let's hear her."

After several vain attempts, the motor half-heartedly consented to run. When Gus jerked at the throttle rod, it sneezed violently and, with a final gasp, died.

"Acts like a bad case of worn valves." Gus said half to himself. "No power and no compression."

"Worn valves, my eye!" snorted Harmon. "The valves are O. K. I just reground and adjusted them. Guess again, Gus."

"Well, seeing's believing," Gus chuckled good-naturedly, "so let's take off the head and have a look. Tell you what I'll do. If it isn't the valves, the job won't cost you a nickel. How's that?"

"Suits me," agreed Harmon. "But I still think it's the carburetor."

Gus opened the drain cock on the radiator and then proceeded to loosen the upper hose connection on the motor.

"Take a look for yourself," he bade, lifting out the motor head. "If those valves aren't burned and pitted, I've never been in a garage. They look more like hexagonal bolt heads than valves. How long ago did you grind them?"

"Not more than a month," Harmon replied. "I did a good job too."

Gus muffled a chuckle. "Maybe you did too good a job, Chet. Too much grinding is worse than none at all. Were they in bad shape when you started?"

"I'll say they were. All burned and pitted."

"When a valve gets that bad you might better throw it out," put in Gus, lifting one of the exhaust valves from place. "You ground this one so long there's a ridge all the way around it. A valve in that condition won't last long. Another thing, never grind a valve to a feather edge. The thin metal on the outside won't stand up two hours in a modern high compression motor."

Gus says:

When you're tempted to cuss and growl because the headlights on another car blind you, remember that your own lights probably aren't much better. Night driving is a serious business and requires good lights, good judgment, and good eyesight. Don't strain your eyes by trying to see with faint, poorly adjusted lights. To be safe, have them tested often.

"I thought they made valves out of tough stuff," Harmon objected. "They shouldn't fall to pieces like that."

"Did you ever singe the back of your hand on the exhaust manifold?" Gus asked. "Well, it get's pretty hot. Around 1,400 degrees, even in cold weather. Being right in the cylinder, the valves get about two hundred degrees hotter than that. The heat alone wouldn't be so bad, but they've got to bob up and down thousands of times a minute into the bargain."

"But the intake valves aren't as badly burned as the exhaust valves," argued Chet.

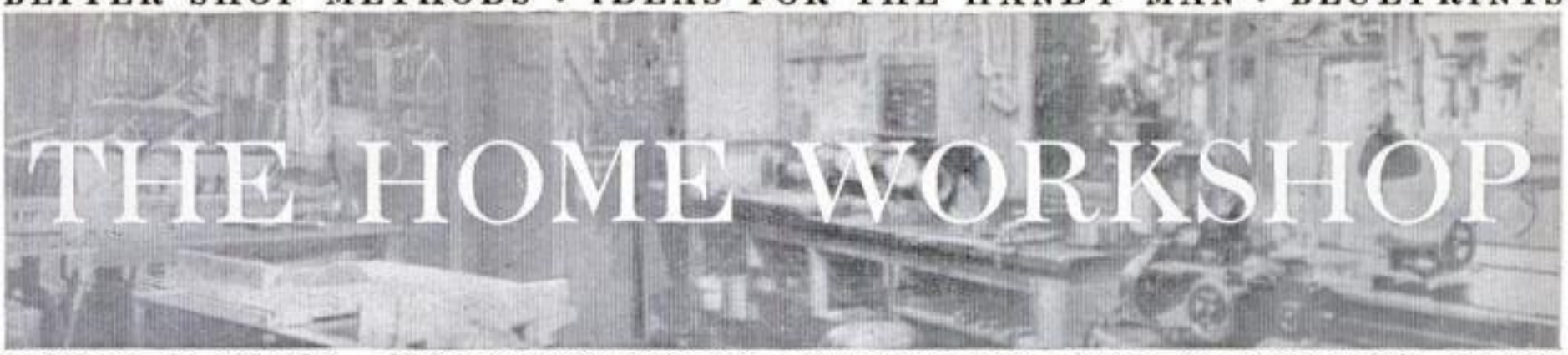
"Of course they aren't," agreed Gus. "Why should they be? The hot gases burn the exhaust valves after every explosion. That's why some car manufacturers put a better grade of steel in the exhaust valves."

"Don't the valve seats burn and warp too?" Harmon asked.

"Sure, but not like the valve heads," Gus replied, pointing to the open valve seat in the motor block. "A valve seat has a lot of metal around it and it's cooled some by the water jacket. The valves, though, haven't much surface to carry off the heat and they're only cooled by the stems and their contact with the valve seats when they close. That's why a valve that doesn't seat properly is bound to burn and warp."

"I never realized that valves took such a beating," confessed Chet. "No wonder they don't last long."

"They will last long," Gus corrected him, "if they're (Continued on page 103)



Jackson putting the newly built outboard racer through her paces. He tested the hull with a "pepped" class "B" motor running wide open and made sharp turns safely in both smooth and rough water

By
William Jackson

THIS NEW Outboard *Speedster*

WILL WIN RACES FOR YOU

SIMPLICITY of construction and strength, combined with safety on the turns, real speed, and unusual rough water qualities, are the distinguishing features of this trim, jaunty little outboard speedster *Scram*. It uses the small but very popular class "A" outboard motors or class "B" motors.

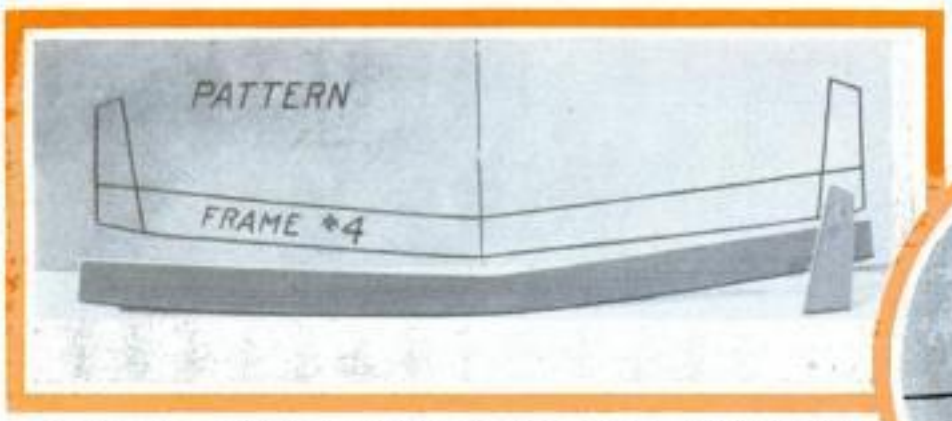
It was designed especially to utilize the power of these motors as efficiently as possible. The original hull, shown at the right, has seen two very successful racing seasons. In nine races, it won six firsts, two seconds, and a third. Several improvements were then made in the design to adapt it to the new and faster motors, and a new hull was built. This is the one shown in all the other illustrations. It promises to give a good account of itself in fast company this season. The new hull has been severely tested on both smooth and extremely rough water and shows no signs of weakening. Sharp turns have been made with a "pepped" class "B" motor running wide open and there was no indication of tripping.

Although designed for class "A" and "B" motors, *Scram* will perform excellently with "C" motors, if the material sizes are increased so as to bring the weight up to requirements.

The improved *Scram* weighs complete, with fin, steering gear, and other essential fittings, 114 lb. The over-all length is 10 ft. 4 in. and the over-all beam 46½ in. This boat was built with spruce frames and mahogany planking. The minimum weight for this class of hulls is 100 lb. The cost of construction should not exceed $35, including the steering wheel and other purchased parts, although the cost will vary somewhat in different localities. The drawings appear on pages 60 and 61, the materials on 86.

This is the original *Scram* with H. S. Beverage, designer and builder, at the wheel. In nine races it won six firsts, two seconds, and one third

How to Build an Inexpensive Little Boat



A full size pattern and two parts cut from it. The patterns should either be purchased or drawn on heavy paper. Lay them on the frame material and prick through the outlines with a marking wheel as shown below. Then saw out and plane the parts

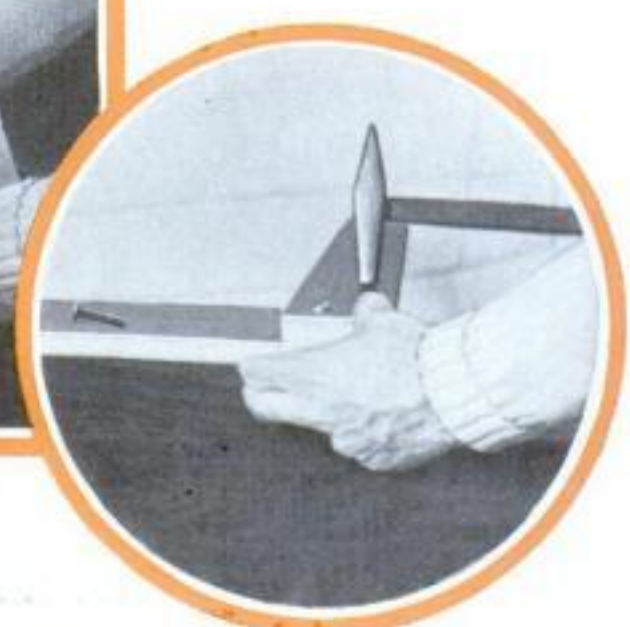
Laying out the full size patterns is made easier by using a template as shown below

To begin the construction, it will first be necessary to construct the form upon which the hull is built. This is sawn out of a 2 by 10 in. by 10 ft. plank. The drawings and photos give complete details. When this is finished, it is mounted on wooden legs like a sawhorse.

Full size patterns of the frames should next be drawn upon heavy paper, unless these are purchased all ready drawn, which saves a great deal of time. Lay these patterns on the frame material so there are no wrinkles on the paper, then prick through the outline of the frame with a marking wheel.

When the sides and bottom members of the frames have been sawn out and the edges planed evenly, lay the members upon the paper patterns so as to conform to the outline, and fasten them together, as indicated, with two 1⅛-in. copper rivets. Drill ⅛-in. lead holes for the rivets before fastening the two parts, and coat the adjoining surfaces with waterproof casein glue. Before the glue sets, see that the frames coincide with the patterns. The rivets on the forward frames are set in somewhat so that the side members may be beveled.

The step frame is constructed as shown in the drawings. Note also the details on page 86. The adjoining surfaces are coated with casein glue and fastened with eight 1¼-in. No. 8 screws in the bottom member and two 1¼-in. No. 8 screws to each side member. All screws are flathead unless otherwise specified and must, of course, be brass or galvanized iron. The transom frame and motor board are next coated with casein glue and secured to the transom with 1½-in. No. 8 screws.



The side and bottom members of each frame are held together with casein glue and rivets

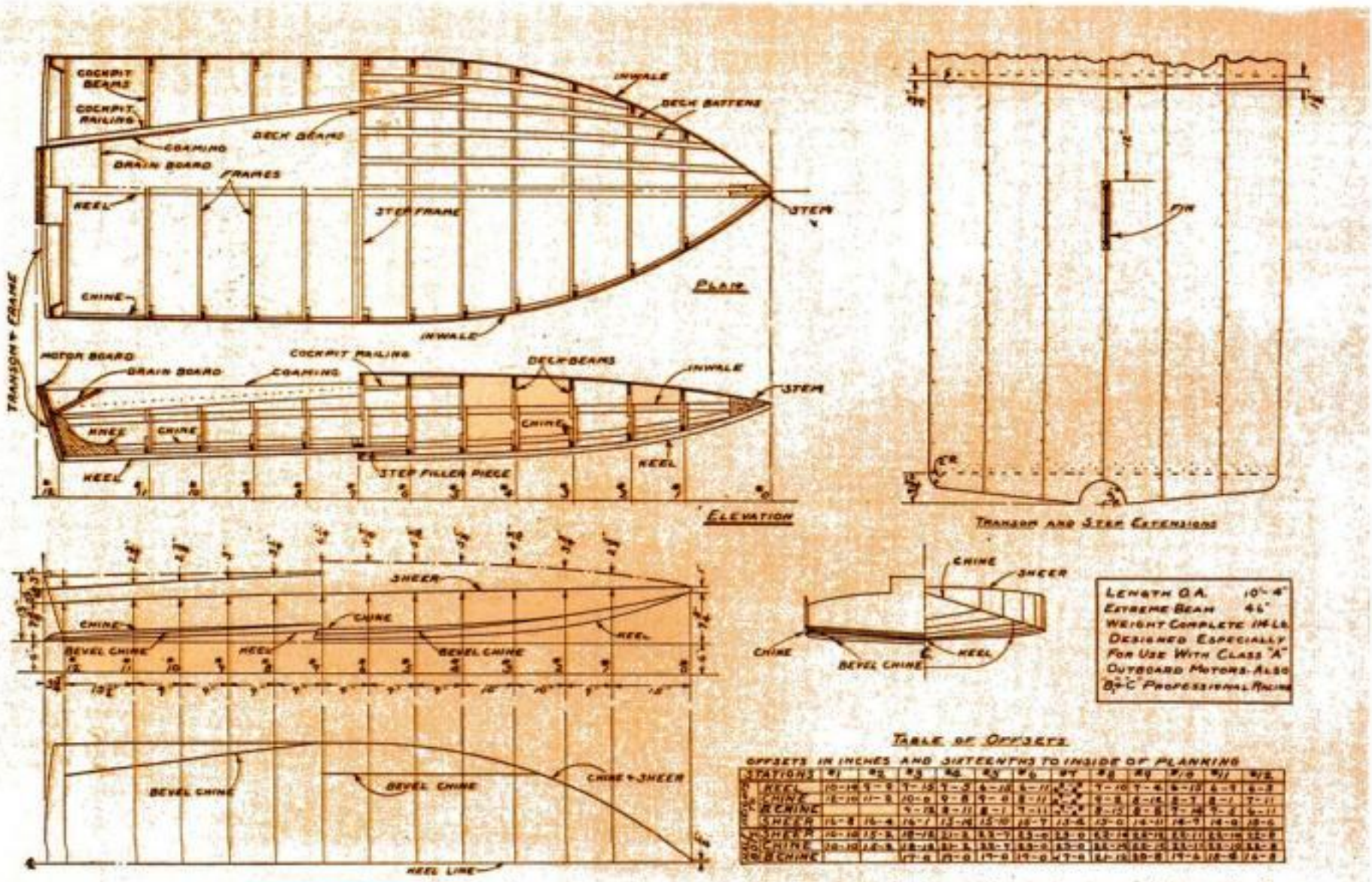


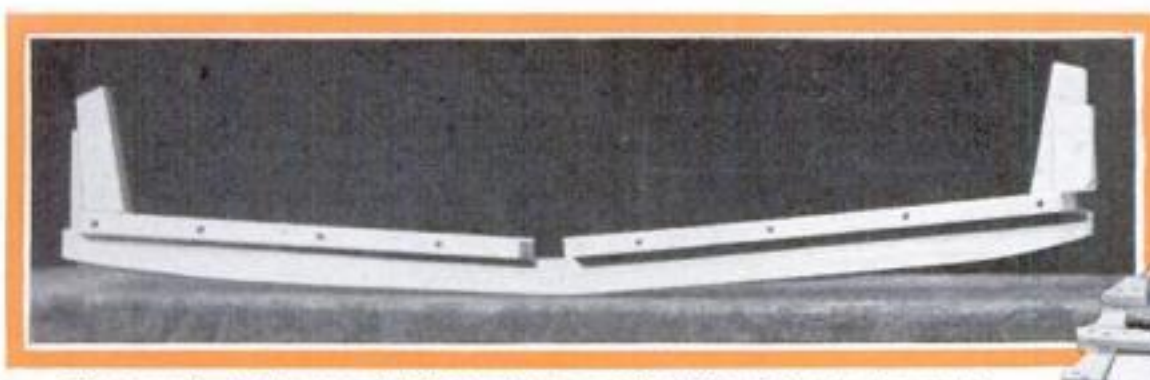
TABLE OF OFFSETS

OFFSETS IN INCHES AND SIXTEENTHS TO INSIDE OF PLANKING

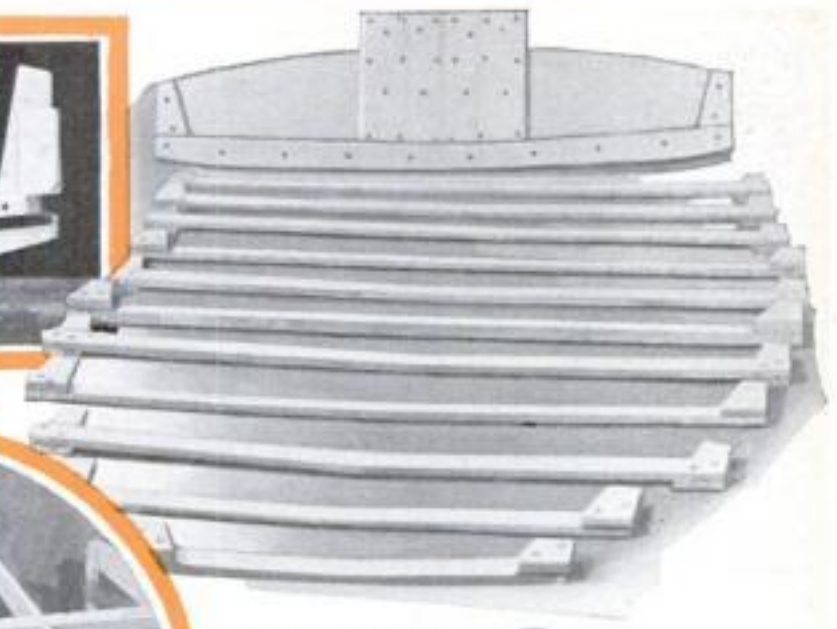
	STATIONS	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12
PORT SIDE	KEEL	10-14	9-0	7-15	7-3	6-12	6-11	6-14	7-10	7-4	6-13	6-9	6-2
	CHINE	13-10	11-5	10-0	9-8	9-0	8-11	8-14	9-2	8-15	8-7	8-1	7-11
	B CHINE			9-12	8-11	8-1	7-11	7-14	8-12	8-5	7-14	7-2	6-11
	SHEER	15-8	15-4	14-7	13-14	13-10	13-7	13-6	13-0	14-11	14-7	14-0	13-6
STARBOARD SIDE	SHEER	15-10	15-5	15-15	15-3	15-7	15-0	15-0	15-0	15-14	15-11	15-14	15-8
	CHINE	13-10	12-5	12-15	12-3	12-7	12-0	12-0	12-0	12-15	12-12	12-15	12-8
	B CHINE			11-8	10-8	10-0	9-0	9-0	9-0	10-8	10-4	10-8	10-2

The assembly views, a bottom view of the transom and step extension, and a table of offsets for those who prefer to work from the figures

Designed for Class "A" and "B" Motors



Photograph of the assembled step frame, marked No. 7 in the drawings



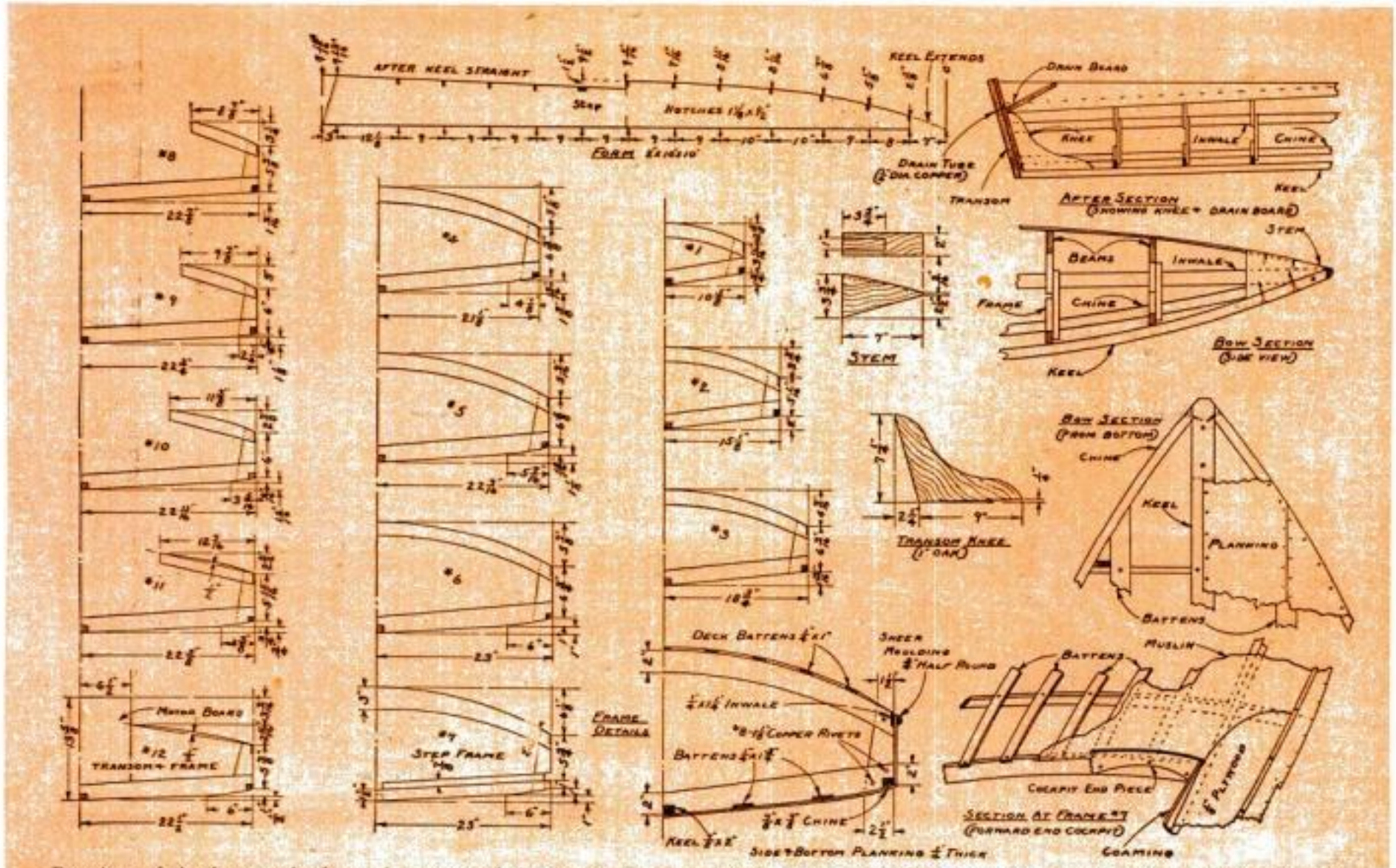
Above: The full set of frames, including No. 12, the transom, and the motor board

The frames from No. 6 to the transom are now properly notched for the chines, keel, and inwale. Temporarily lay frames Nos. 5 to 1 in the form notches, and, bending a light batten around the frames, mark on the side members the correct bevels. Remove from the form, bevel the side members, and cut the keel, chine, and inwale notches.

The frames are now placed in their respective notches on the form. The transom should be temporarily fastened to the form. The keel is fastened to each frame with two 1½-in. No. 8 screws. A few screws instead of clamps may be used to hold the keel to the form, but be sure to remove the screws before the planking

(Continued on page 86)

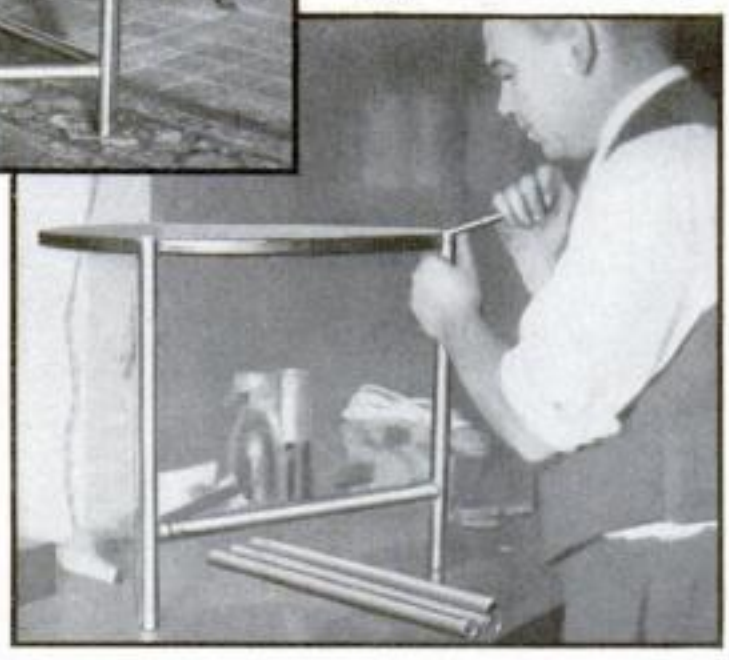
How the framework is assembled on the form and, in circle above, a larger view of the temporary braces placed at the step



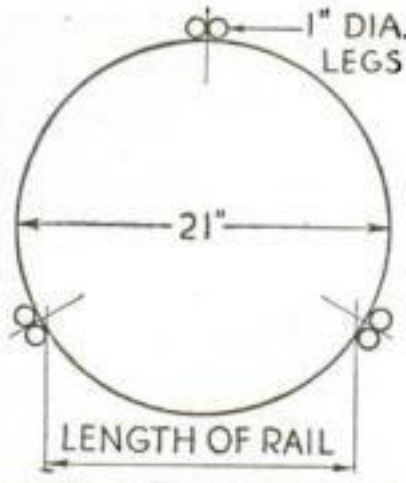
Drawings of the frames, the form, the stem, and the transom knee, and explanatory views of the bow, stern, and forward end of the cockpit

Tubes from Old Brass Bed Make Frame for Fine Coffee Table

This costly looking, modern coffee table was made on a Saturday afternoon from parts of an old brass bed



In assembling, the screws are inserted at a slight angle. *Above:* Layout for finding length of rails



HAVE you an old brass bed in your cellar or attic storeroom? If you have, it is a gold mine for your home workshop. From it you can make floor lamps, modernistic table lamps, smoking stands, and small tables.

Here is how to go about making a coffee table like the one shown. First get your bed. Some ingenuity will have to be exercised in taking it to pieces, but that is part of the fun. Then get the board for the table top. I used the top of a discarded school desk. The top could be made from a couple of old extension table leaves glued together, but anything you can get that will give a round top about 21 in. in diameter will do.

The legs were made from six tubes taken from the head of the bed, cut to a length of 18 in. The rails, which are set 4 in. up from the bottom of the legs, were made from three tubes taken from the foot of the bed. Their length was found by making the layout shown in the accompanying diagram. This was drawn full size on a sheet of wrapping paper. Holes had to be drilled and screws inserted at a slight angle in order to get them through the side of the tube that touched the table top. The method of assembly is illustrated at the left. The rails were fastened to the legs with the fastenings used originally on the bed itself; these were merely reset on the shortened rails.

After the table had been satisfactorily assembled, it was taken apart and the brass tubes were buffed and given a coat of clear lacquer. The top was sanded, stained walnut, and French polished, that is, given a padded shellac finish. Then the pieces were reassembled and wood buttons were turned, polished, and driven into the tops of the legs. The inside of each leg at the bottom was soldered for solidity, and the table was then ready for use. The whole job was completed in one Saturday afternoon.—E. C. WITTICK.

A PUZZLE SHIFTER

Using a tiny suction disk to shift parts of a picture puzzle

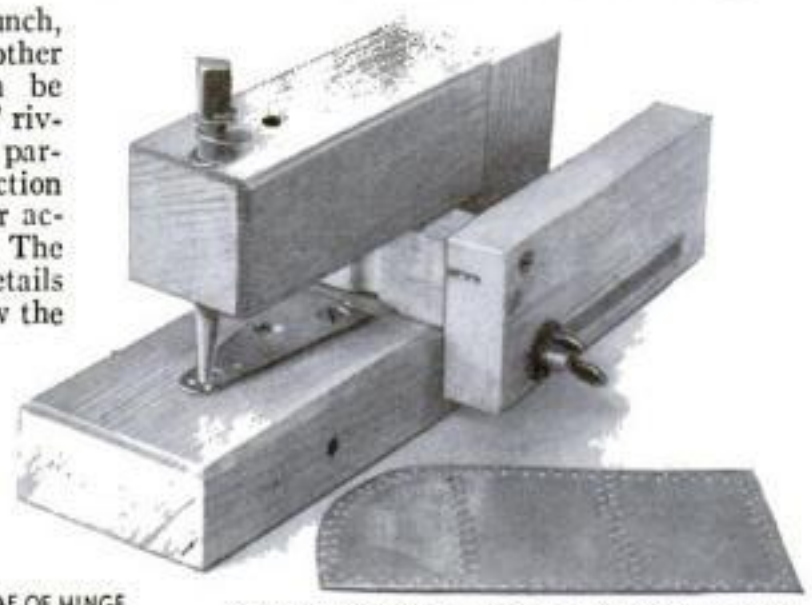
TO THE real picture puzzle fan, the smaller and more irregular the pieces, the more absorbing is the task of assembling them. The writer has found that it helps to use a puzzle shifter like that shown at the right. The small cuplike rubber tip, when lightly pressed against one of the pieces, allows it to be moved, turned, slipped in and out of spaces in which it may fit closely, and all with little danger of disturbing the assembled parts of the puzzle. The spring allows the holder to be held and worked at a convenient angle.

To make such a tool, obtain an old tire valve core spring and a small metal capped gasket out of a tire valve cap. The latter may be readily pushed out with a small nail. Punch a hole through the metal top of the gasket, place one end of the core spring over it, and expand the metal top until the spring is tightly held. This can be done with the point of an ice pick. It is better, however, to use solder to join the two parts securely. Force the other end of the spring over the point of a lead pencil or, better yet, a small pointed dowel stick.—FRANK W. BENTLEY, JR.

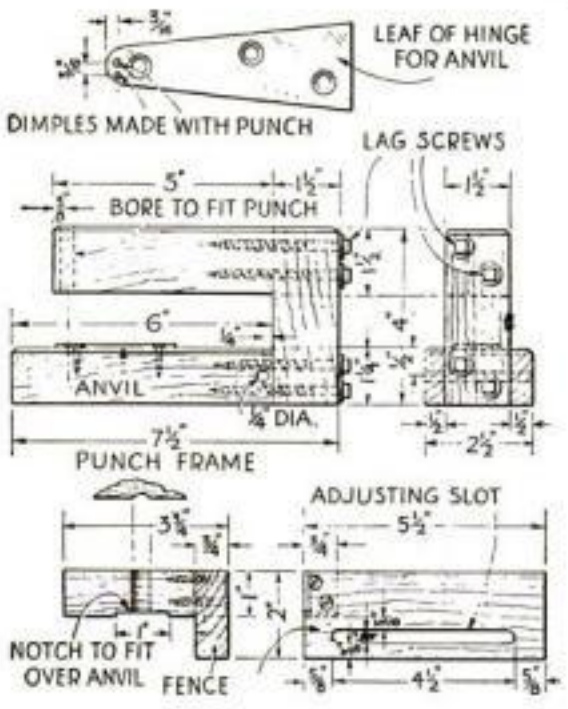
PUNCH FOR FORMING DUMMY RIVETS

WITH the aid of this punch, miniature girders, tanks, and other metal parts of models can be quickly embossed with "prop" rivet and boltheads. The tool is particularly useful in the construction of bridges, towers, and similar accessories for model railways. The drawings below gives the details and the photograph shows how the parts are assembled.

Make a prick punch with a slightly rounded point from an old nail set, fitting it with a spring to raise it after the stroke.



The assembled punch and a specimen of its work. *At left:* Detail drawings of the parts



Insert it in the guide hole to locate the die socket position in the hinge leaf that is used for an anvil. Remove the latter, rest it on a firm base, and punch the dimple to a full 1/16-in. diameter. Make a second dimple as shown, at a distance equal to the desired spacing.

To use the punch, adjust the fence, lay a strip of tin or other thin sheet metal face downward, and strike the punch with a light hammer. Move the strip until the embossed rivet fits into the second dimple, and punch again. This gages the spacing.

Cardboard and celluloid can also be embossed with this tool for gluing or cementing over wooden forms. After being painted, they are almost as realistic as if made of metal.—EDWIN M. LOVE.

SIMPLE SLIPKNOTS FORM THESE

Indian Wampum Belts

By Kenneth Murray

Fig. 1. The completed belt and, at the right below, a view of the buckle end slightly larger than full size. The buckle is 1 in. wide, and the colors are blue and gray

DECORATIVE beaded effects like those to be seen on skillfully woven Indian wampum belts can be imitated with simple slipknots. Belts that are knotted together in this manner are very durable. The one illustrated was made with size 16 silk cord in blue and silver gray as a gift for a woman. For a man, belts of this type should be made with heavy wax-finish cord.

To make a 34-in. belt, cut four strands of gray 25 ft. long and one of blue 48 ft. long. These are doubled and looped directly on the buckle as shown in Fig. 2 at the left. Start tying as illustrated in the series of views on page 90. Use the left-hand cord as a filler, and over it tie two of the slipknots with each of the next four cords. How to tie these knots is shown very plainly in the first photograph in that series (Fig. 7). Draw the knots up tight to give a bead effect as shown in the second photograph of Fig. 7 (the top one at the right). Use the right-hand cord as a filler and add two knots with each of the following four cords. The filler cords will then be in the center. Add two knots over the one coming from the right with the one from the left as shown in the third photograph of Fig. 7.

It is now necessary only to repeat this method of knotting, row after row, until the blue cords automatically arrive at the outsides as shown in the fourth photograph of Fig. 7 and also in the center view of Fig. 2. They are then knotted twice over each of the four adjoining cords, which returns the blue to the center (fifth and sixth views of Fig. 7 and Fig. 2, at right). This (Continued on page 90)

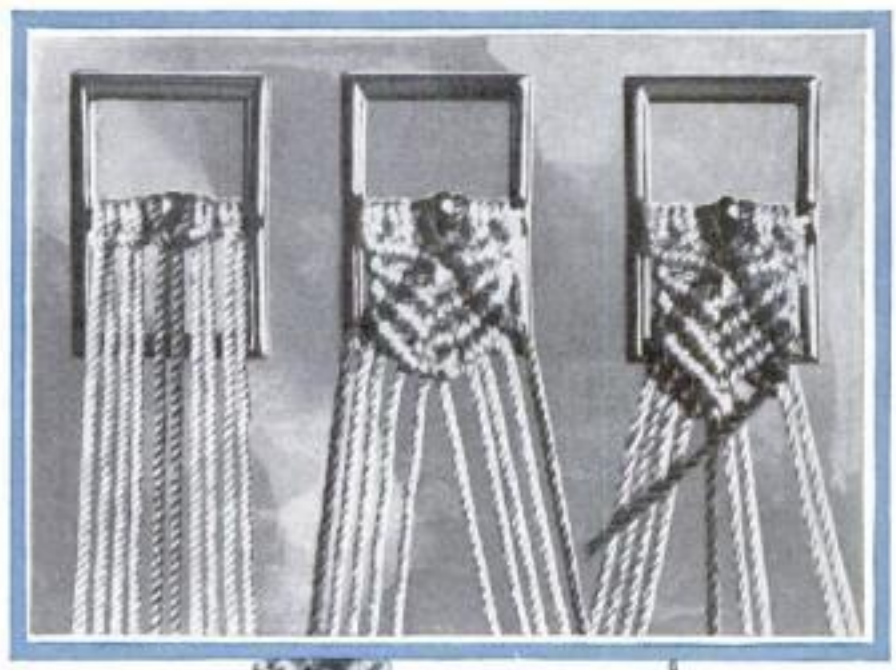


Fig. 3. The belt is ended with the blue cords in the center for 5 in. Holes are unnecessary as the buckle tongue can be pushed through the belt easily

Fig. 2 (in rectangle). The cords looped on the buckle, the first half of the diamond design, and how the blue cords are returned to the center

Fig. 4. Three alternative designs are shown below. In the center one, a single white cord acts as a continuous filler. Any pattern can be worked out

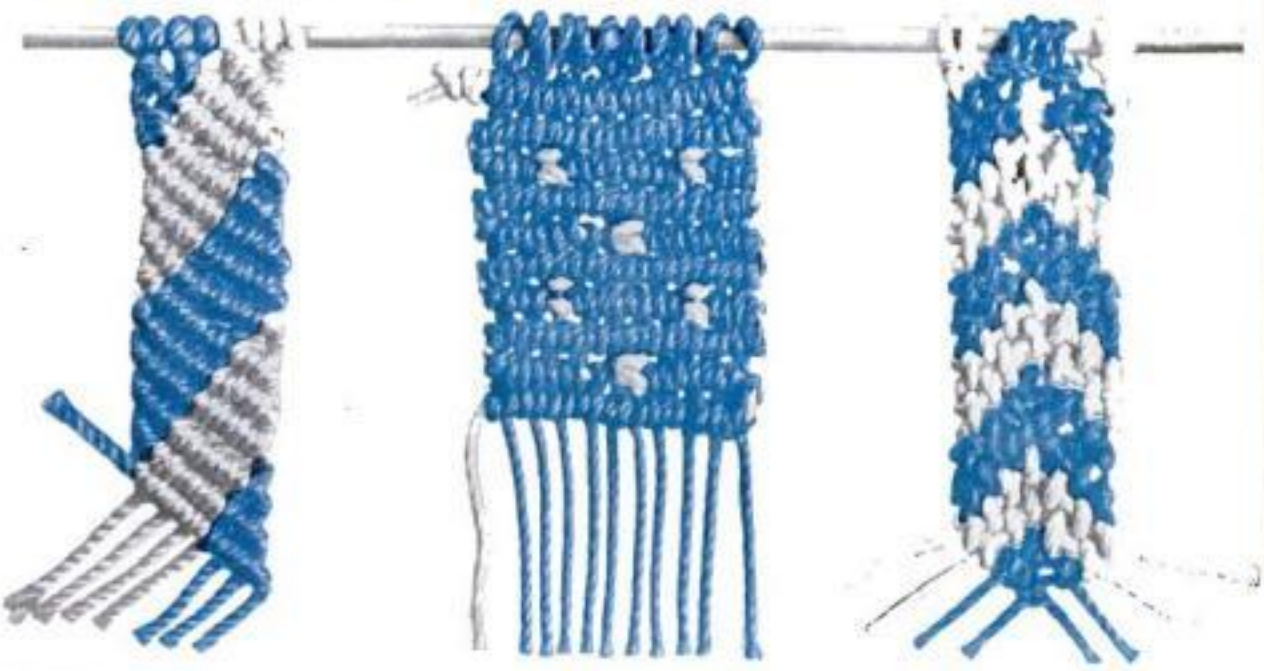


Fig. 5. For convenience, tie the long cords into hanks at a point several feet from the knotting

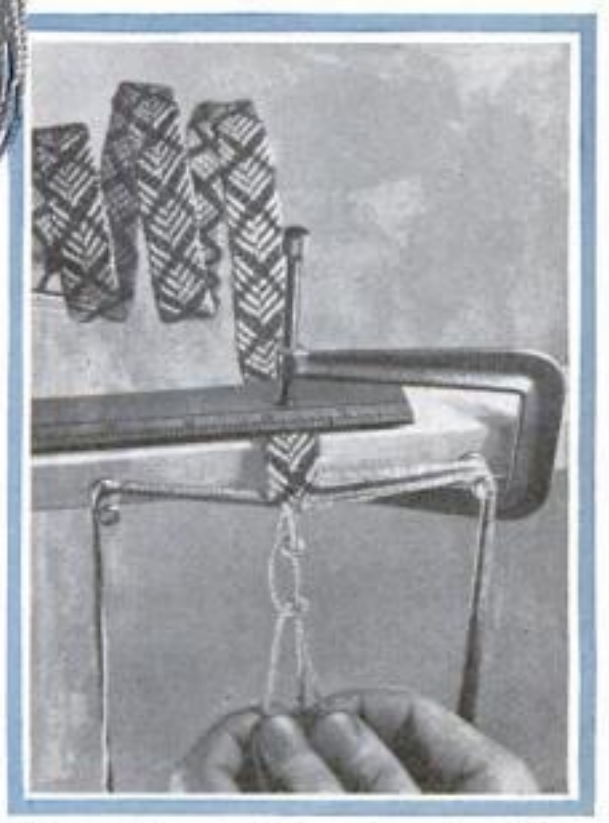
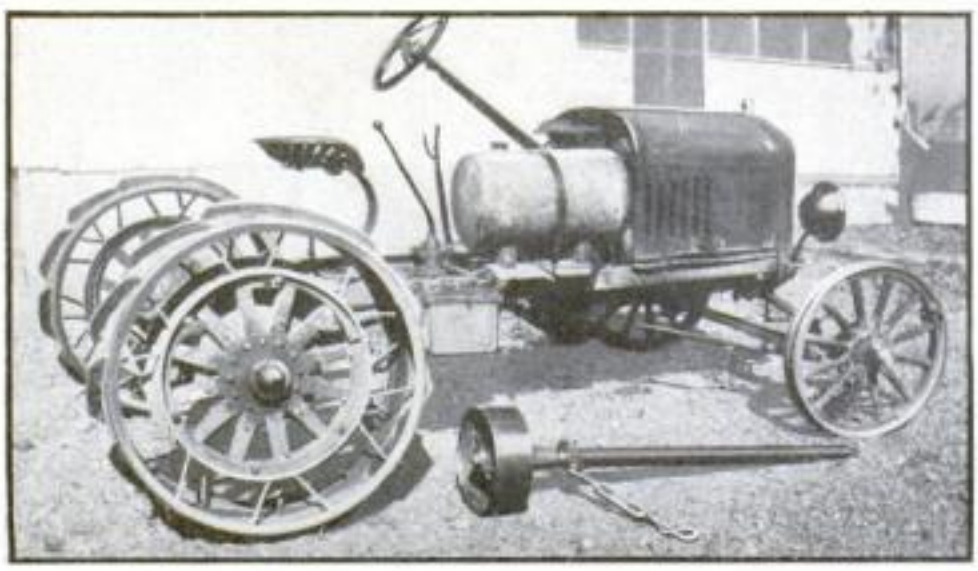


Fig. 6. The work is kept in order with a ruler, a small C-clamp, and two push pins

Farm Tractor and Power Plant Assembled from Old Auto Parts



This piece of farm machinery won second prize in our recent Auto Engine Contest. It cost $12.50, but the builder did his own machine work and welding

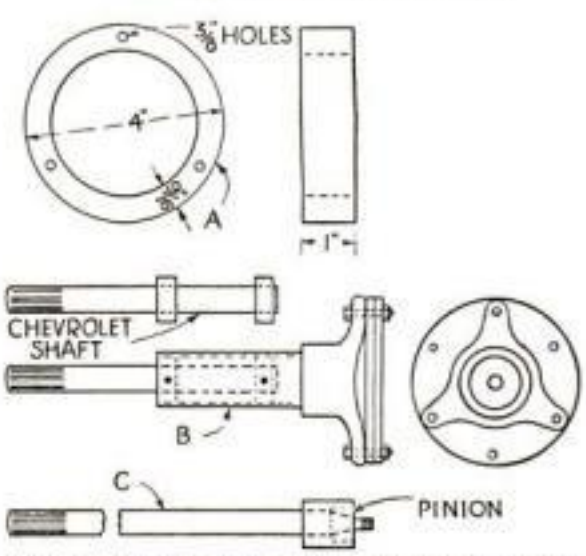
THIS combination tractor and belt power plant was made from a Ford engine with frame and front wheels, a 1925 Chevrolet gear shift, an International Model-S truck rear end, and two binder wheels. The frame was shortened 18 in. by sawing each side in two 23 in. from the rear end and lapping and drilling for two ½-in. bolts. The rear end was set on two 2 by 5 in. steel posts with U-bolts around frame and axles.

The front shaft of the gear shift was removed and machined to fit into the rear end of the Ford engine. The rear half of a universal housing was obtained from another gear shift and the holes filed a little to fit the engine. A steel collar was turned as at *A* to form a spacer between gear shift and engine. Three 1¾ by ⅜ in. studs were made, holes were drilled, and the gear shift was bolted to the engine. A piece of 1½-in. angle iron was bolted on the frame above as an additional support; and two ½-in. bolts with short pieces of ½-in. pipe for spacers over the bolts make it very rigid.

The tractor drive was made by sawing off the 2-in. tube drive shaft to rear end (some of this waste made the two posts previously mentioned) and using an old Chevrolet shaft that had a good front end. Two rings were turned to take care of the difference in diameter and drilled through for two 5/16-in. bolts as at *B*.

The pulley shaft was made from a complete Chevrolet transmission shaft. The pinion was removed and annealed, then replaced on the shaft and turned off to the base of the teeth. A bushing was turned to a shrink fit over the pinion as shown at *C*. We used a pulley of 12 in. diameter with 4 in. face. The tube was put in the lathe and about ¾ in. cut off the end. It was then threaded on the inside and a nut made to screw in against the outer ring of the ball bearing.

Removing three bolts from the rear universal allows the short drive shaft to be pulled out and the pulley shaft pushed into place.—J. C. MILLER.

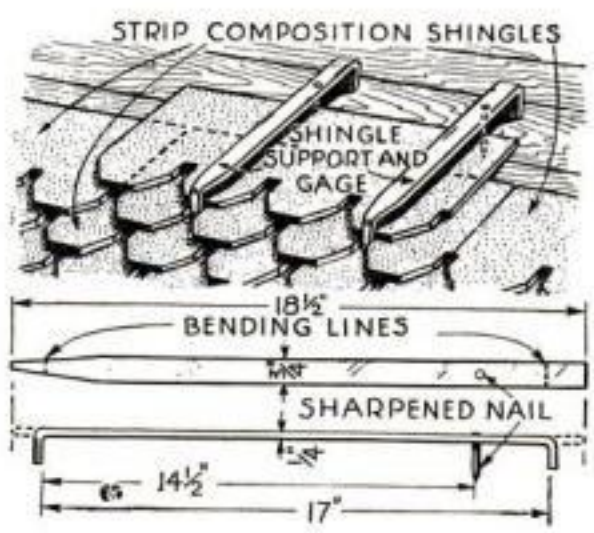


These diagrams illustrate the principal work it was necessary to do in the machine shop

A hookless fastener prevents loss of change or small articles from pockets of overalls or other working clothes

SAFEGUARDING POCKETS OF WORK CLOTHES

MOST mechanics have at times lost money or other articles of value from the pockets of their overalls or the trousers of their working clothes. This can be prevented by closing at least one of the pockets with a hookless or zipper type fastener. In the writer's case, a fastener salvaged from a discarded work shirt was cut off and sewed in place.—A. V.

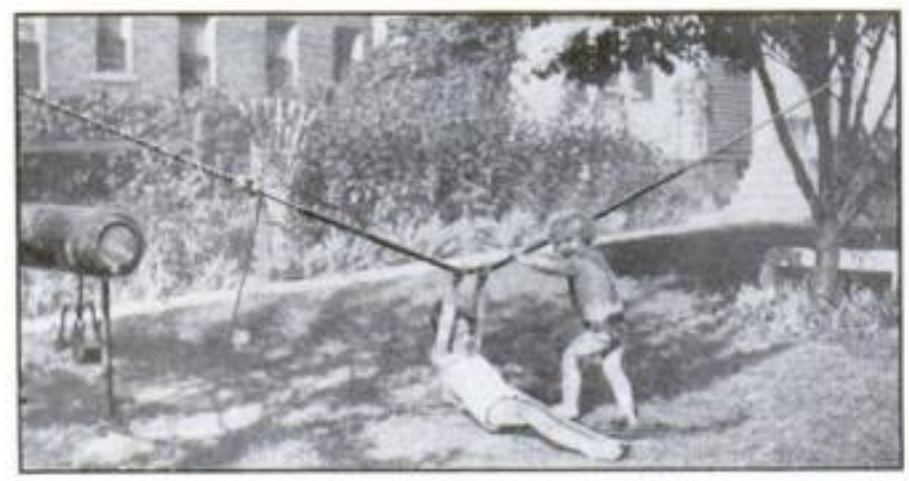


SPEEDY WAY TO NAIL STRIP SHINGLES

IN LAYING strip composition shingles on a roof, a pair of irons made as shown at the left will save much time. They keep the strip in place and allow both hands to be used for nailing, whereas when the shingle is held with one hand and the nailing done with the other there is always danger that it will slip. When sufficient nails have been driven, the irons are removed and placed in the slots of the shingles ready for holding the next strip.—P. K. ZEBRE.

OLD GARDEN HOSE GIVES CHILDREN FUN

A GARDEN hose that no longer holds water makes excellent covers for trapeze bars and other equipment used in a children's playground. The device shown consists of a rope running through an old piece of hose and secured at either end to a tree limb. The limb should be small enough to give considerable spring. If trees are not available, a spring may be cut in the line. A rope at one end is used by the smaller children to pull the hose down so they can reach it. This device looks uninterestingly simple, but children will play at it vigorously.—D. A. BUTLER.



The rope is incased in a length of discarded garden hose and tied at each end to a tree limb so as to give it considerable spring

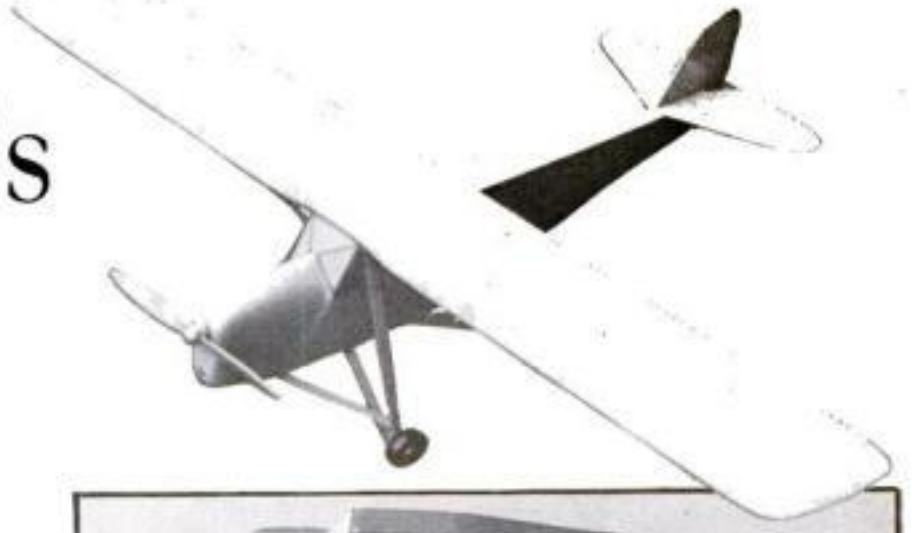
An easily built model of

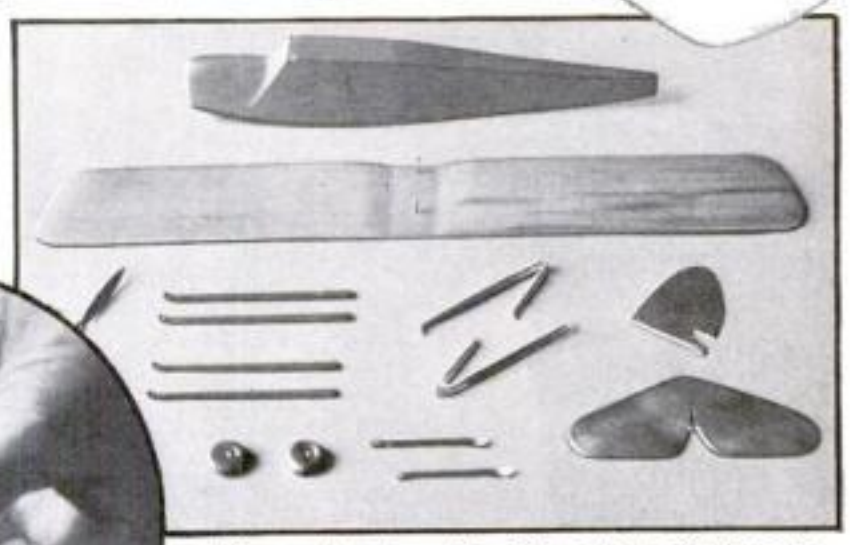
Capt. Mollison's

famous transatlantic

MONOPLANE

By Donald W. Clark





The completed model and its sixteen simple parts. Its wing spread is 12¾ in. and the fuselage is 8¼ in. long. The scale of the model in relation to the full size plane is ⅜ in. equals 1 ft. *At left:* Slipping the horizontal tail into place

A MODEL of *The Heart's Content*, the favorite plane of Capt. J. A. Mollison, England's famous long distance flyer, makes an interesting addition to any model builder's group of planes. It was in this little plane that he recently flew from England to Brazil, crossing the South Atlantic in one hop of 1,885 miles.

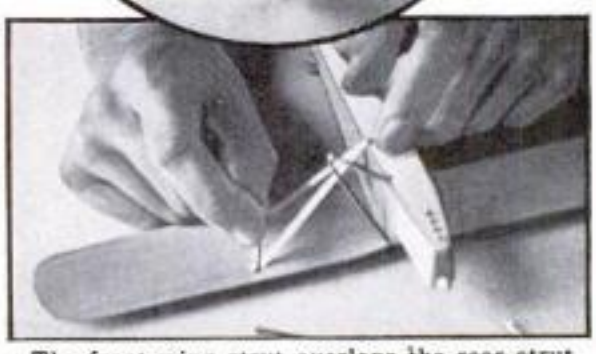
The fuselage is whittled from soft pine. Only one tail slot is needed. Make two notches, as shown, to take the upper ends of the struts marked *A*. Four ¼-in. lengths of 1/16 in. diameter wire, set into holes, will serve as exhaust pipes.

Cut out the wing, shape to an air-foil section with a small plane, and cut out where it is to be "gulled."

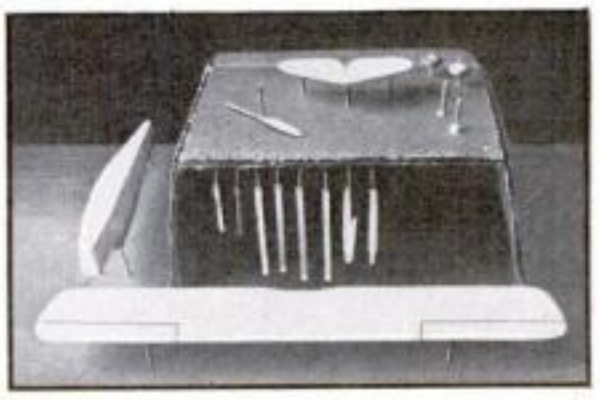
Make the tail units, propeller, and all struts of thin aluminum. Struts *B* need to be twisted slightly so they will fit snug against struts *A*, where they are fastened with tiny aluminum rivets. Short lengths of pins can be used to hold the struts to the wooden parts.

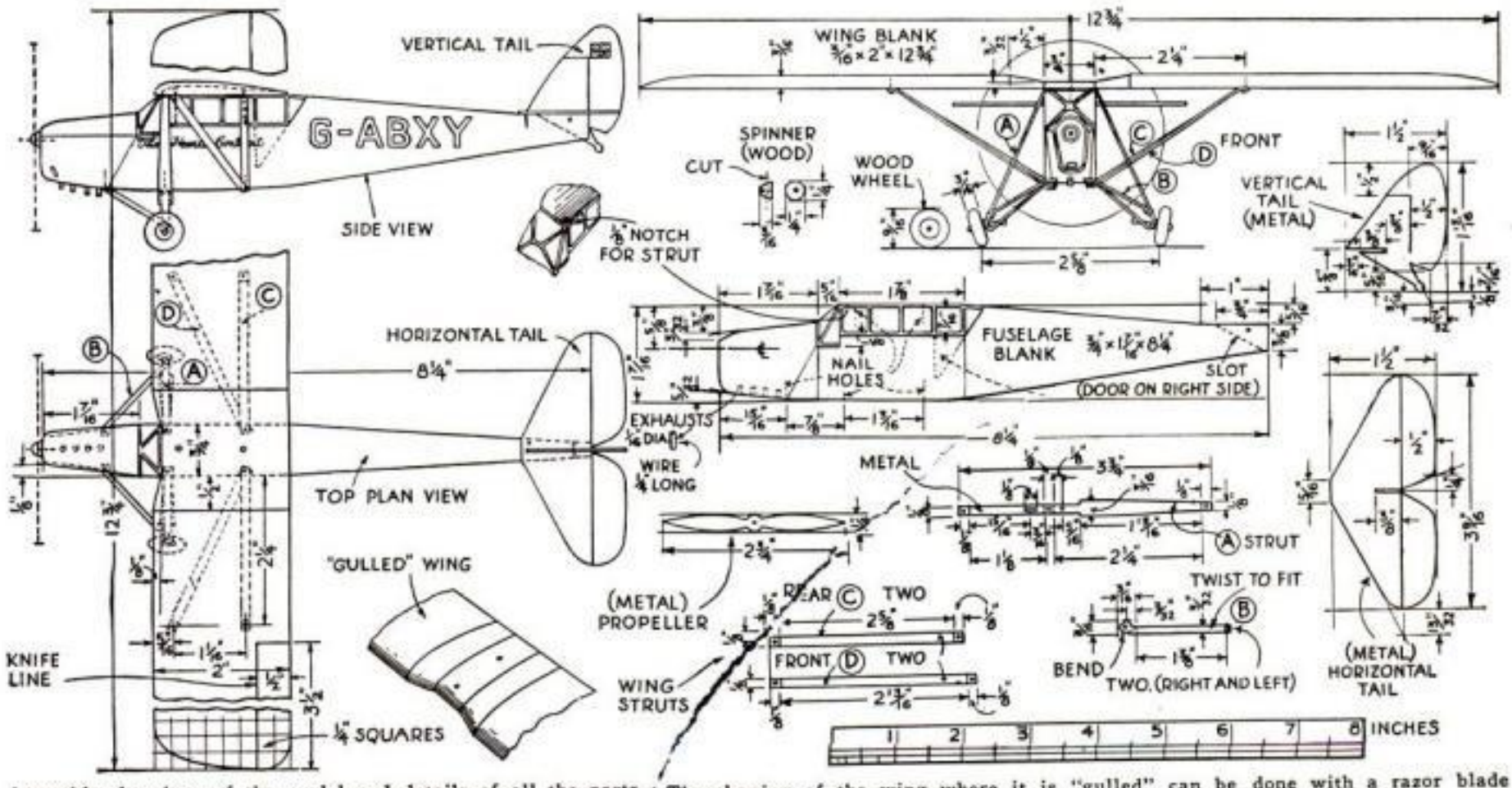
The wheels are made of wood, rounded and sanded. Pins will do for the axles.

The model illustrated was given two coats of cream color paint and afterwards trimmed with black. Dark brown could be used instead of black, but make the tires black, also the name and number if these are added. Polish the propeller.



The front wing strut overlaps the rear strut at bottom. *Right:* Drying the painted parts





Assembly drawings of the model and details of all the parts. The shaping of the wing where it is "gulled" can be done with a razor blade or a sharp knife; cut the slopes first and remove the middle portion afterward. The one tail slot can be cut with a fine hack-saw blade

Concrete Stepping Stones Cast in Flexible Metal Forms

PROBABLY the most artistic and practical path for the lawn or garden is one that is made of stepping stones. When laid out in a natural manner, such a path will harmonize perfectly with any plan of landscaping, whether formal or informal. Contraction and expansion cannot effect it, and no subsequent attention is required except occasionally to mow the grass which grows between the stones.

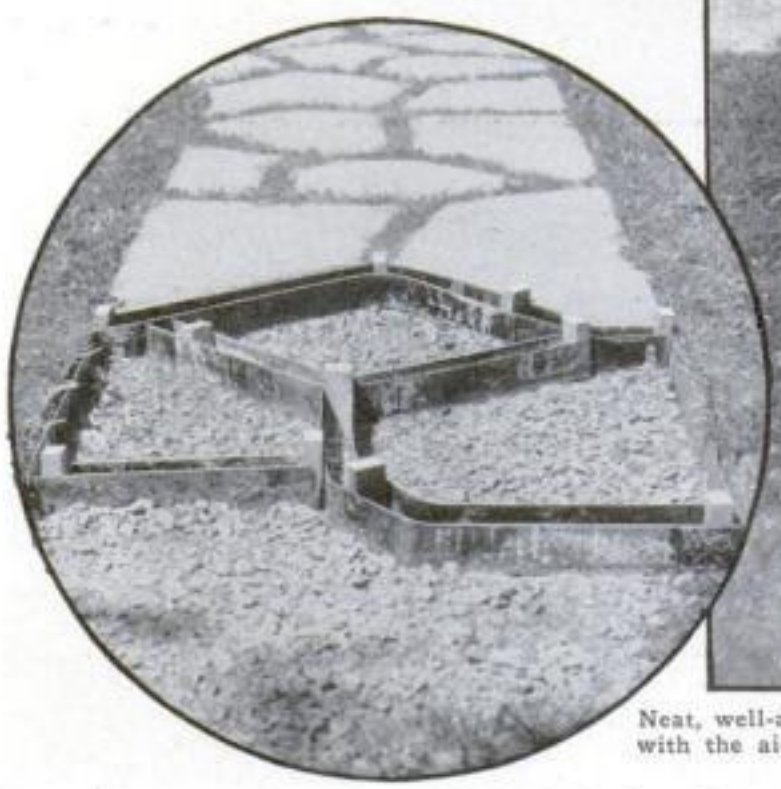
The material used in constructing such a path may be either natural stone or molded concrete stone. In most localities natural stones of a suitable size and thickness are both expensive and difficult to obtain. Concrete stepping stones, however, when cast directly in place by the following method of using flexible forms, can be laid easily and economically and can scarcely be distinguished from the natural stones. By using the same forms, stones of various sizes and shapes can be cast quickly and permanently.

Lay out the path to the desired width and contour, and remove the ground to a depth of 2 or 3 in. A thin layer of sand or gravel should be put in the bottom to assist in keeping the forms in place. The side strips and flexible forms are next arranged as desired. These consist of strips of any light gage sheet metal 2 or 3 in. wide and of various lengths of from 1 to 3 ft. The strips may be cut from old scraps of sheet metal found around every garage or junk yard; and inasmuch as rust, dents, and other imperfections are not in the least detrimental, they may generally be obtained for the asking. No great supply of these strips is required, because after the concrete has remained in the forms for about an hour they can be removed and used over again.

Set the forms so that the stones, when cast, will be about ¼ in. above the ground level. This will insure adequate drainage in wet weather and still be low enough so that the lawn mower can pass over the walk easily. To keep the forms properly spaced, insert small wooden blocks 1½ or 2 in. wide wherever needed.

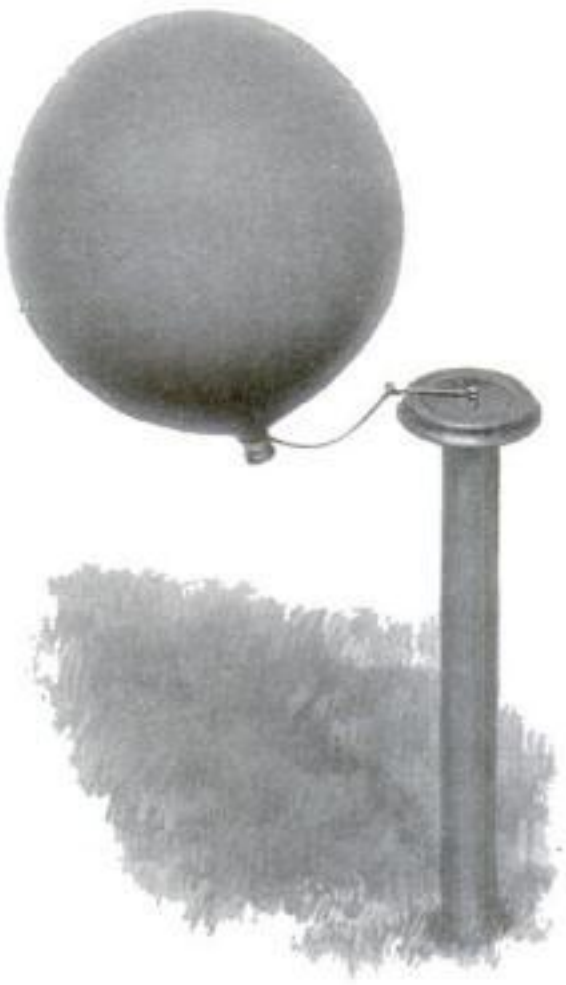
The concrete mixture recommended for this class of work is 1 part of cement to 5 parts of coarse sand. If dry sand is used, the correct amount of water for the mixture is 5½ gal. for each sack of cement used. Place the mixture in the forms and smooth the surface carefully with a trowel or float. If desired, the walk can be slightly crowned so that water will run off more readily.

Concrete should never be permitted to dry out rapidly. As soon as the mixture has set, it should be covered with old sacks, pieces of burlap, or the like, and these should be kept moistened for several days. Fill the spaces with soil and plant grass seed.—L. C. PELTIER.



Neat, well-arranged stepping stones are easily made with the aid of forms like those shown at the left

BALLOON SCARES BIRDS FROM GARDEN



TO FRIGHTEN birds away from a berry patch or a newly planted lawn, where they often do considerable damage in a short time, home gardeners sometimes tie a slightly inflated paper sack to a stick. When it becomes damp, however, the bag is useless, and the string is always getting fouled on the stick. A more efficient and lasting device is shown at the left.

Get a small red toy balloon, inflate it moderately, tie it, and leave the string 4 or 5 in. long. Then drive a stick into the ground and nail on top of it the tin cap of a small preserve bottle or can, letting the head of the nail project slightly. Bend the end of a short piece of stovepipe wire loosely around the nail, and bend another eye in the other end slightly beyond the edge of the tin. Tie the balloon string to the outer eye. As the breeze blows the balloon about, the wire slips around on the tin, and the string cannot catch. It will be found that even rain will not affect the balloon, which will stay inflated for days.—F. B.

Birds can be kept from a newly planted lawn or garden patch by tying a small toy balloon to a stake in such a way that it will bob around and around in the breeze

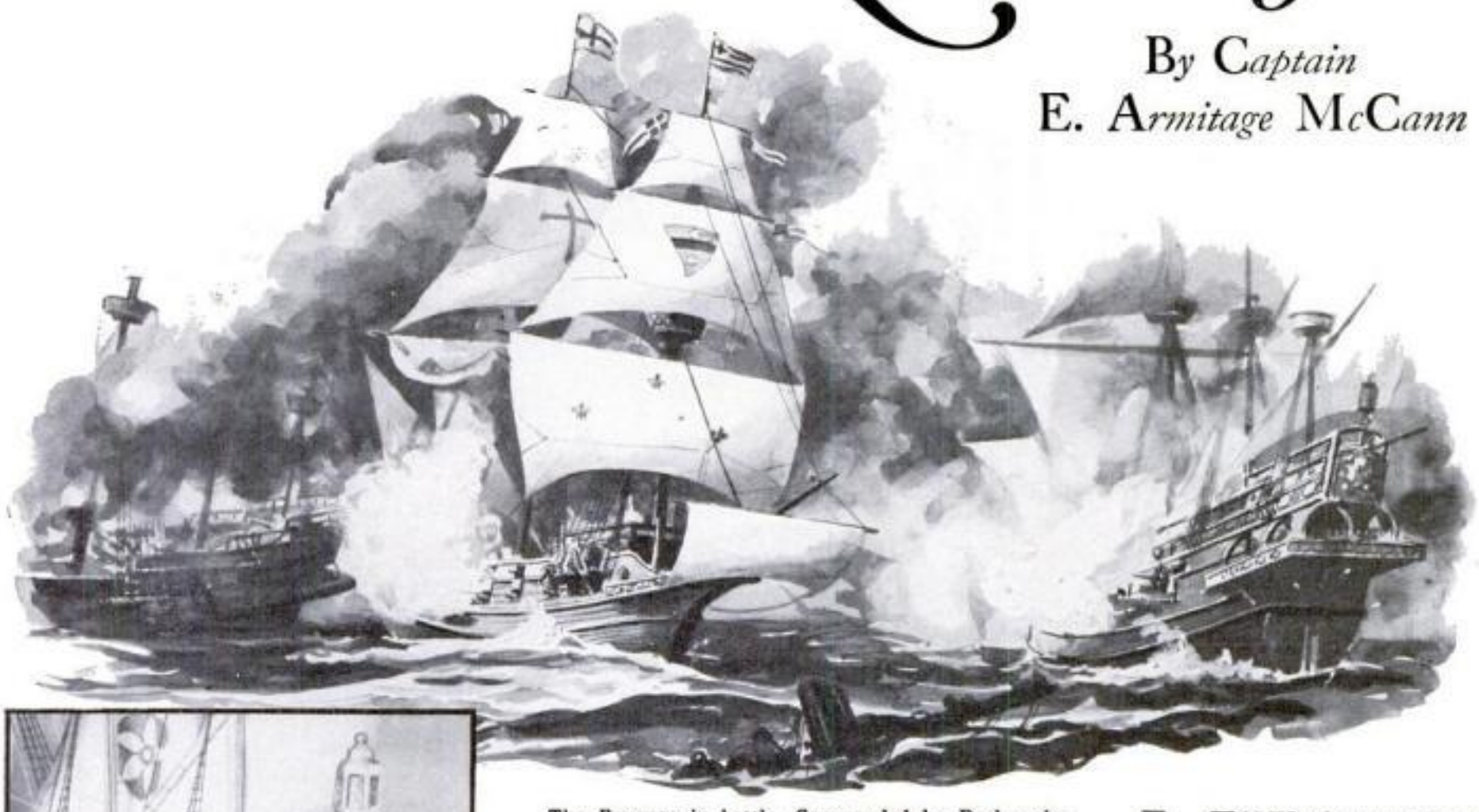
ELASTIC IN WIRE FENCE PREVENTS TRIPPING

TRIPPING over low wire fences around flower beds or newly planted grass plots may be prevented by the method illustrated above. A heavy elastic band cut from a discarded inner tube is inserted in the fence by cutting the wire and tying the two ends to the rubber band. The elastic must be strong enough to keep the wire taut. When a person walks into it unknowingly, the wire will give sufficiently so that he will be able to catch himself.—LEONARD MITCHELL.

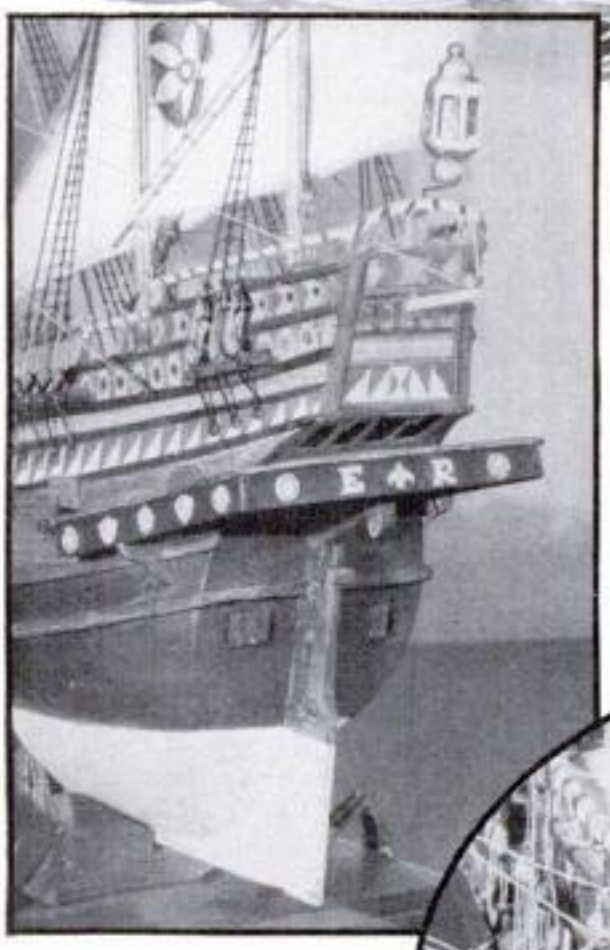
Finishing the Hull of Our New Model

THE FAMOUS GALLEON "*REVENGE*"

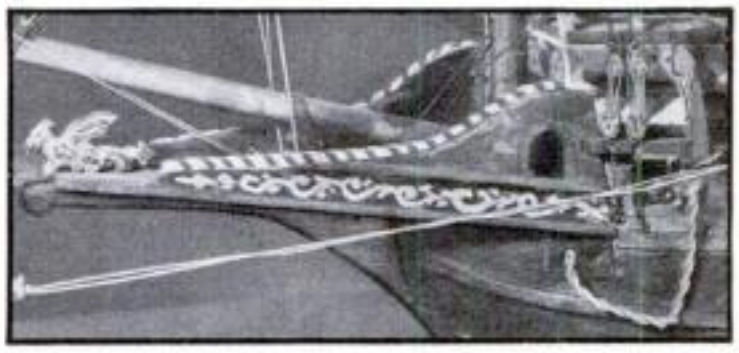
By *Captain* E. *Armitage McCann*

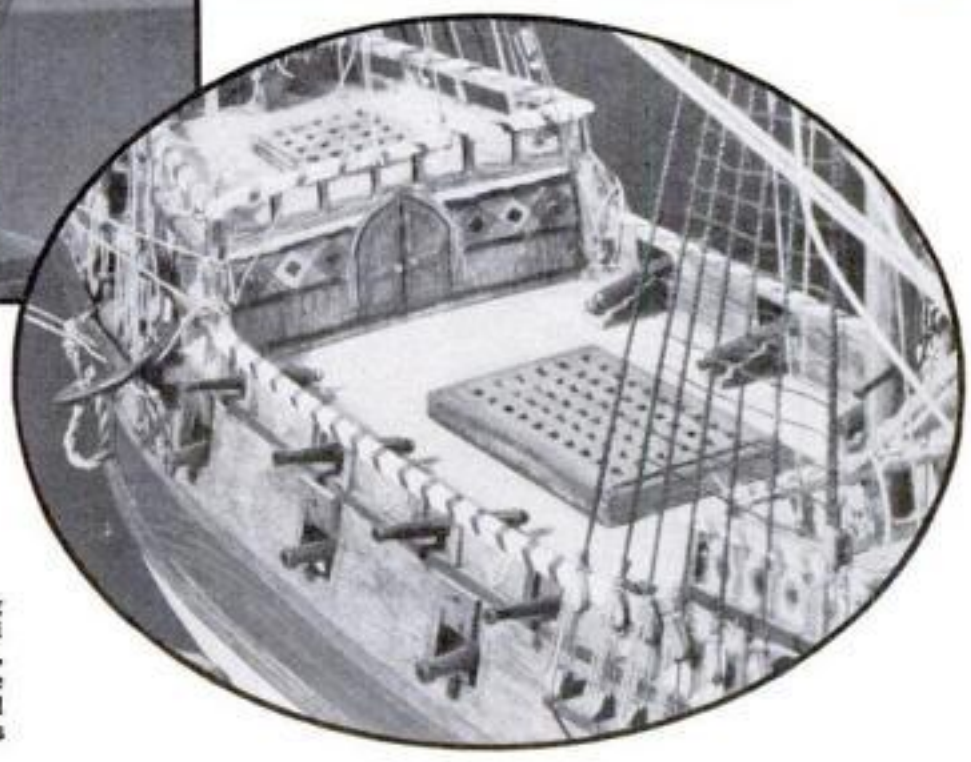


The *Revenge* in battle. Commanded by Drake, she helped defeat the Spanish Armada, and later engaged fifty-three Spanish galleons at once. *Below:* The figurehead and beak, showing the painted decoration



The high stern. Note the highly decorative lantern and the projecting stern gallery, which is black on the outside and ornamented with gay painted shields and the royal cipher





The waist of the ship, looking forward. This shows the finished appearance of the guns, hatches, and overlay *g*. On the outside all the handrails are painted white with diagonal red stripes

MANY thousands of POPULAR SCIENCE MONTHLY readers make a hobby of building ship models. They continue year after year. Some of them have constructed every one of our long series of models. Why do they do it?

If you have built models, you will know the answer, but if you have never tried this most satisfying form of craft work, why not begin making a model and find out for yourself? You could not start with a better model than our new one of the Elizabethan galleon *Revenge*. This is a particularly colorful and picturesque model, yet it is simple to construct, does not require any previous knowledge of ships or model making, and calls for no unusual accuracy or mechanical skill.

The model is just the right size for use as an ornament in the average small home. What will appeal to almost everyone, too, is the fact that some of the most thrilling stories of the sea are connected with the *Revenge*. The memory of her gallant battles have come down to us through 350 years.

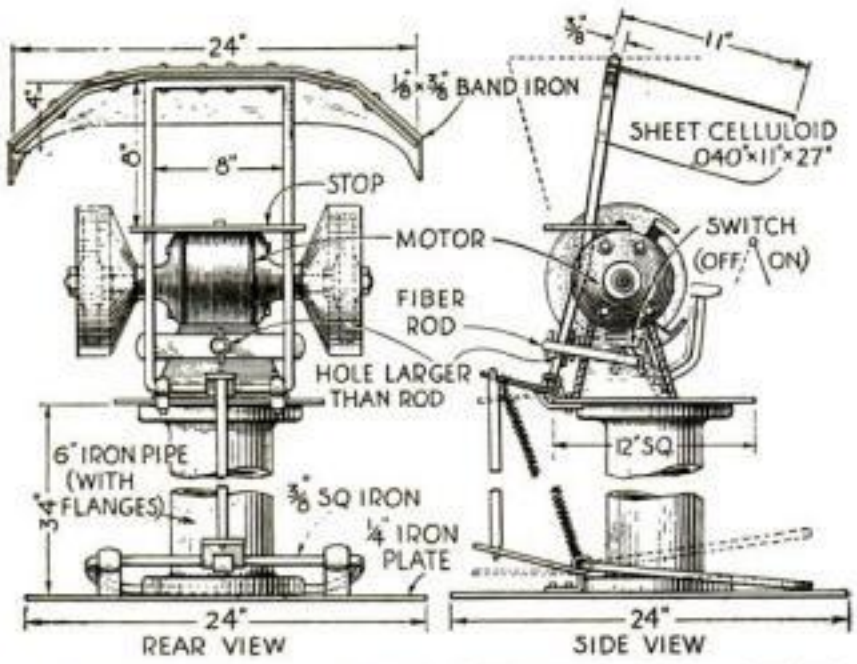
They were great fighters, these *(Continued on page 89)*

PEDAL OPERATES FOOLPROOF GRINDER SHIELD

THIS foolproof grinder shield, an invention of the writer's, has proved satisfactory during months of constant use by different mechanics, and has been praised by safety and insurance officials. When the operator steps on the pedal, the transparent shield pivots forward over the grinder wheels and in front of the worker's face. At the same time, a switch, hidden in the base of the motor and connected by means of a fiber tube or rod to the shield supports, is thrown on.

The advantages of the shield are: It protects the operator's eyes and face; it is clean and sanitary; the grinder cannot be used without the shield; the operator cannot leave the grinder with the power on; and there is a psychological advantage in that the shield, by pivoting back and forth, keeps the operator constantly aware of it, therefore it is not abused or damaged.

Since grinders vary greatly in their size and shape and in their mountings, pedestals, and other details, I have omitted many of the measurements for this particular assembly. Incidentally, the pedestal illustrated is one that is easily and cheaply made up and is excellent for drills, vises, and the like, as well as for a grinder. The principal requirement is that the shield proper extend forward and to the sides far enough to shield the operator's face completely and to have it far enough above the wheels for clearance.



General arrangement of the pedal operated shield and switch. The dimensions must be adapted to suit the grinder being used

In this instance, the toggle switch that came mounted on the front of the base was removed, an extension was added to the toggle, and it was then fastened inside the base as shown on the drawing. The pins in the fiber rod are set far enough apart to compensate for the difference in the radii of the toggle arm and the shield support. An advantage in using sheet celluloid for the shield instead of glass, aside from the fact it does not break, is that it is not cut by the flying fragments as is glass, which soon becomes blurred.—BYRON TAYLOR.

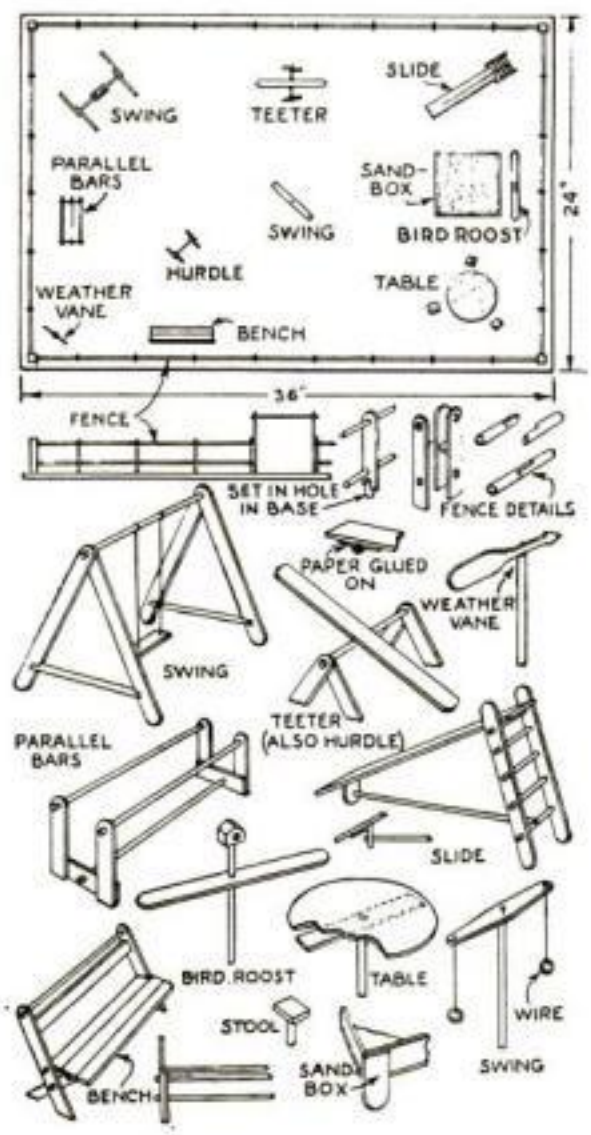
When the pedal is pressed, the shield swings forward and the motor starts

PLAYGROUND IN MINIATURE

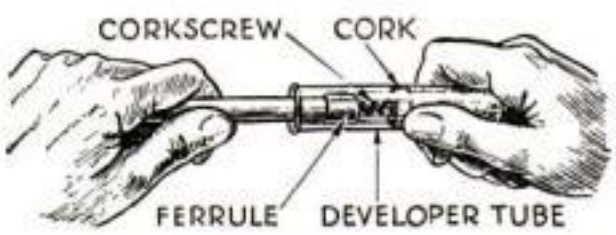
Doll houses and farmyards are old favorites, but here is something new—a toy playground

MINIATURE toys, such as the realistic little playground illustrated above, have a strong appeal for the younger children, particularly if they can shift around the various objects to suit themselves and really play with them.

The playground apparatus, table, bench, stools, weather vane, and sand-box can be made easily from scraps of cardboard, lollypop sticks or similar round sticks, and a few thin, flat sticks of the type used as handles for various ice-cold confections sold to children. A supply of these, a little glue, some string, and a piece of 2 by 3 ft. fiber wall board for the base are the only materials required; and for tools it is sufficient to have a razor blade, pocketknife, small hand drill, ruler, and pencil. Paint the apparatus with quick drying enamel or other glossy finish.—D. W. C.



Plan view giving a suggested layout of the playground, and drawings of the equipment



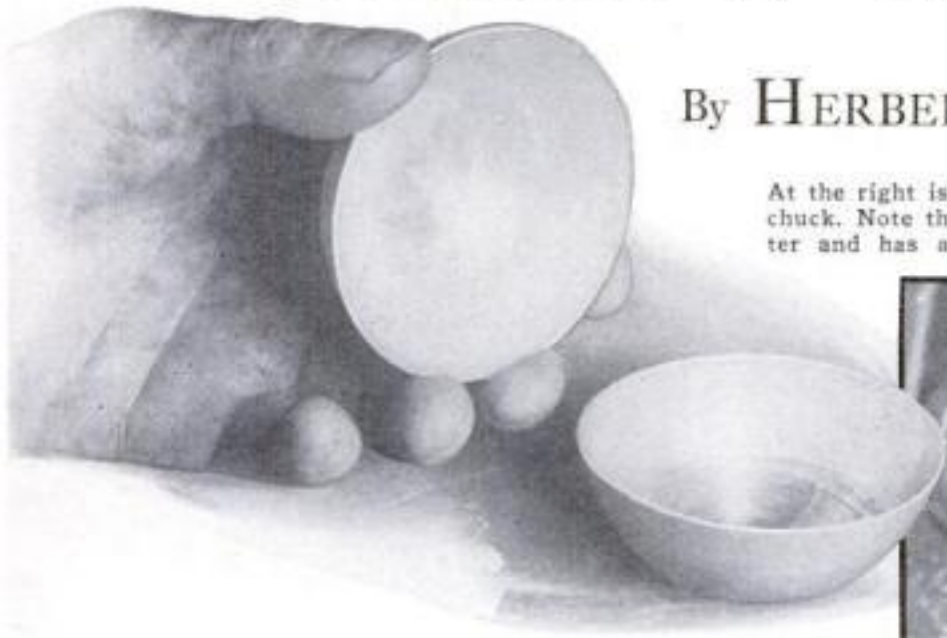
LONG CORKSCREW OPENS DEVELOPER TUBES

GLASS tubes containing photographic developers often have a second cork halfway down to separate one chemical from another. An ordinary corkscrew either will not reach the cork or is too coarse to use with so delicate a cork and therefore merely breaks the cork. The corkscrew illustrated, however, is long enough to reach to the bottom of any developer tube on the market and at the same time is fine enough to pull the cork without breaking either it or the tube.

This corkscrew is made from a 6-in. length of 3/8-in. wooden dowel rod, a ferrule, and a small corkscrew similar to that supplied with many varieties of mouthwash bottles. Cut the ring from the small corkscrew and solder the twisted wire to the threaded part of a wood screw from which the head has been removed. Drive the ferrule onto the end of the dowel, drill a small pilot hole, and screw in the wood-screw end of the corkscrew. A coat of shellac will protect the handle from the developers.—RONALD L. IVES.

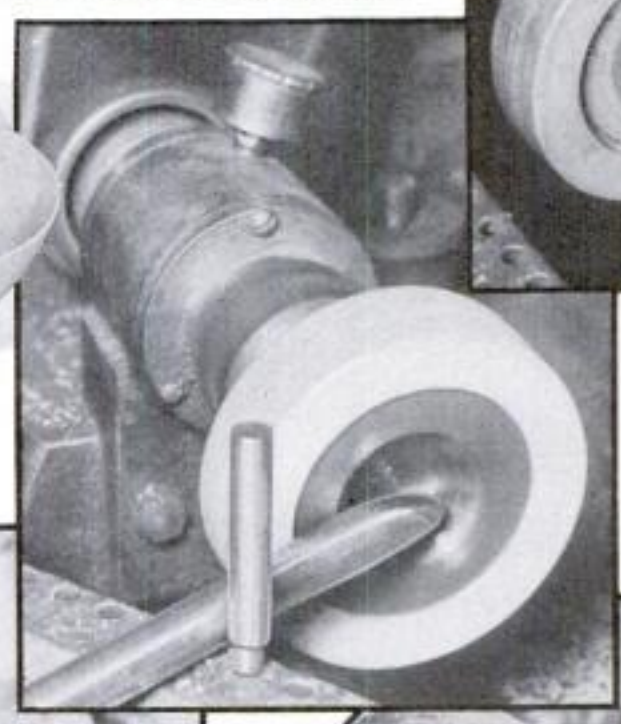
How to SPIN *a* Hollow Metal Sphere

By HERBERT WOOLSEY

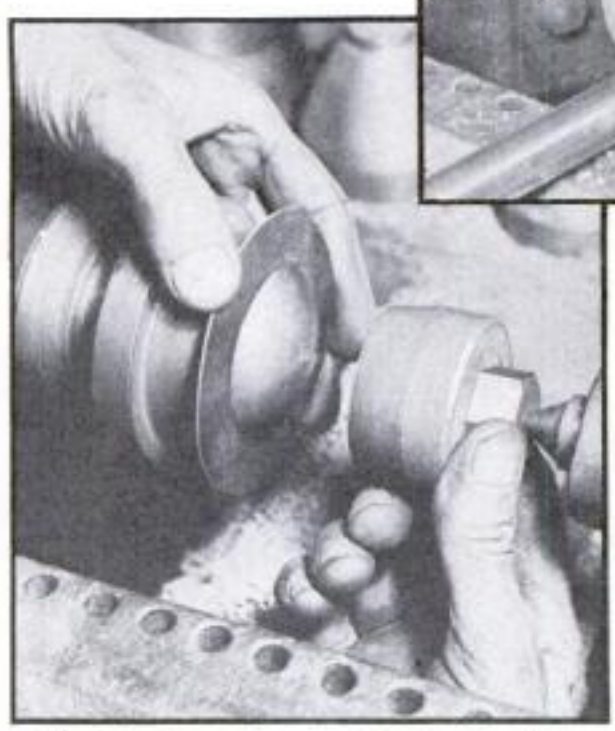


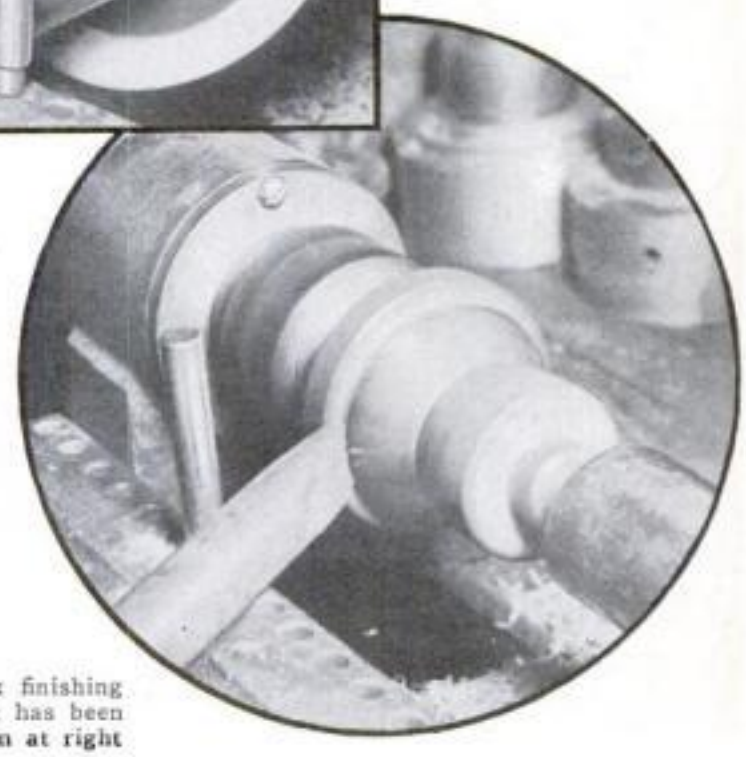
The two finished hemispheres ready to be soldered or brazed together. Two forms are used in spinning, one a concave starting chuck and the other a convex metal finishing form

At the right is shown the wooden starting chuck. Note that it is concave in the center and has a recess to take the blank



To start the spinning operation, the disk is placed in the wooden chuck and the center of the blank is pressed into the hollow part of the form as shown at the left. A round-nosed tool is used for this work





Placing the partly spun blank over the convex finishing form. If necessary to replace the work after it has been removed, center it with the back stick as shown at right

AFTER you have made a start in the fascinating art of metal spinning and learned the various processes described in the two previous articles in this series (P. S. M., Mar. '33, p. 64, and Apr., p. 76), you will be ready to undertake what looks to be an exceedingly difficult piece of work, yet is simple enough when once the method is understood—spinning a hollow metal sphere.

The easiest way is to make two hemispheres and solder them together. This is, indeed, the method often employed in industry. For this you will need two chucks, one being a metal form for the complete hemisphere, and the other a wood or metal starter with a concave depression in the center that corresponds to a slice from the surface of the finished sphere. There is a rim around the starter chuck to hold the disk in place while it is being spun. If an attempt were made to start the disk directly against the final hemispherical form, it would touch only at a point, and there would not be sufficient drag to turn it.

After the starter chuck has been made, place the disk in it and, with a round-nosed tool, spin the center into the depression. The work at this point will look somewhat like a wide-brimmed hat or trench helmet. Spin the other half of the sphere to the same degree, and then replace the starter chuck with the second or finishing form.

Reverse the blank so that the hollow part will fit over the nose of the chuck. Next place over this a wood adapter or "follower" that has been turned previously so that the part resting against the disk is concave. Run the back center against this adapter, and spin the remainder of the hemisphere. Try to avoid making a ridge where the first stage of spinning stopped.

After the hemispheres are trimmed and smoothed, solder them together to form a perfect sphere, and buff the surface until the seam does not show.

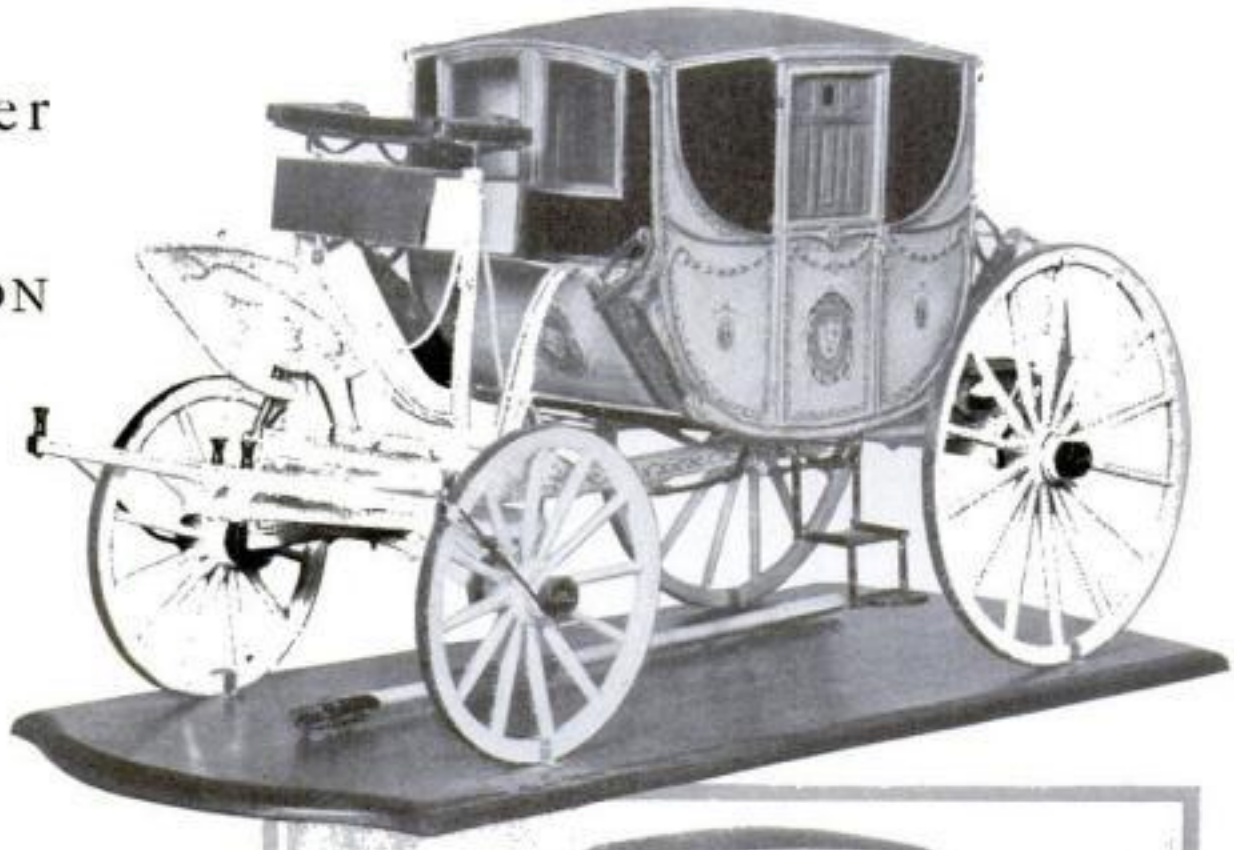
In doing many other spinning jobs, you will find it necessary to start the work in a concave chuck so that subsequent spinning can be performed in the usual manner, with the blank held firmly against the form by a wood back-center adapter.

There is one simple job of spinning that the owner of tools will find useful. This is the spinning of metal collars or ferrules about the handles of chisels, screw drivers, wood turning tools, knives, and other tools. Place the handle in a chuck with the end which is to take the tool projecting. A three-jawed chuck can be employed if provisions are made to prevent scratching the wood. Cut a disk having a radius slightly greater than the desired collar and place it against the handle, holding it with a back-center button. Then spin the disk down and around the handle, forming a collar. It will be forced so tightly against the wood that it never will come off, particularly if a groove or two is formed with a sharp-nosed tool. Finally, drill a hole to receive the shank of the tool that is to be set into the handle.

This is the third of a series of articles on metal spinning. The fourth, on spinning with sectional chucks, will appear in an early issue.

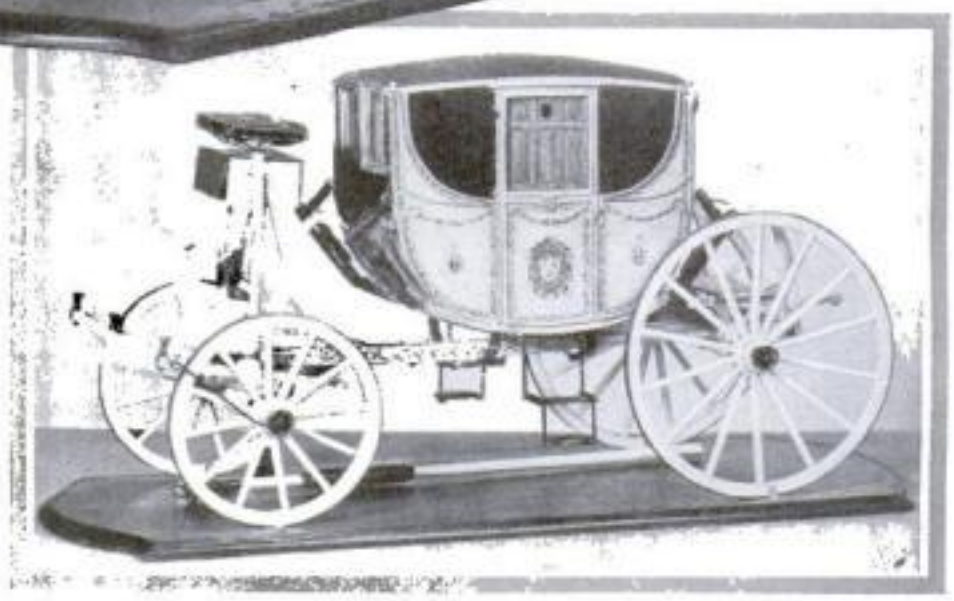
New PLANS for a Beautiful

First Prize Winner in our GEORGE WASHINGTON COACH CONTEST



RARELY has a coach model of finer craftsmanship or more graceful design been built than that which won first prize of $100 in our George Washington coach model contest. It is the work of H. G. Bryant, of New York, and was built on a scale of ⅛ in. equals 1 in. from careful measurements and sketches he made of the original coach, which is now in the possession of the New York Historical Society.

The coach was owned by the Beekman family in Revolutionary times and, according to the family traditions, was used occasionally by Washington when he was visiting New York.

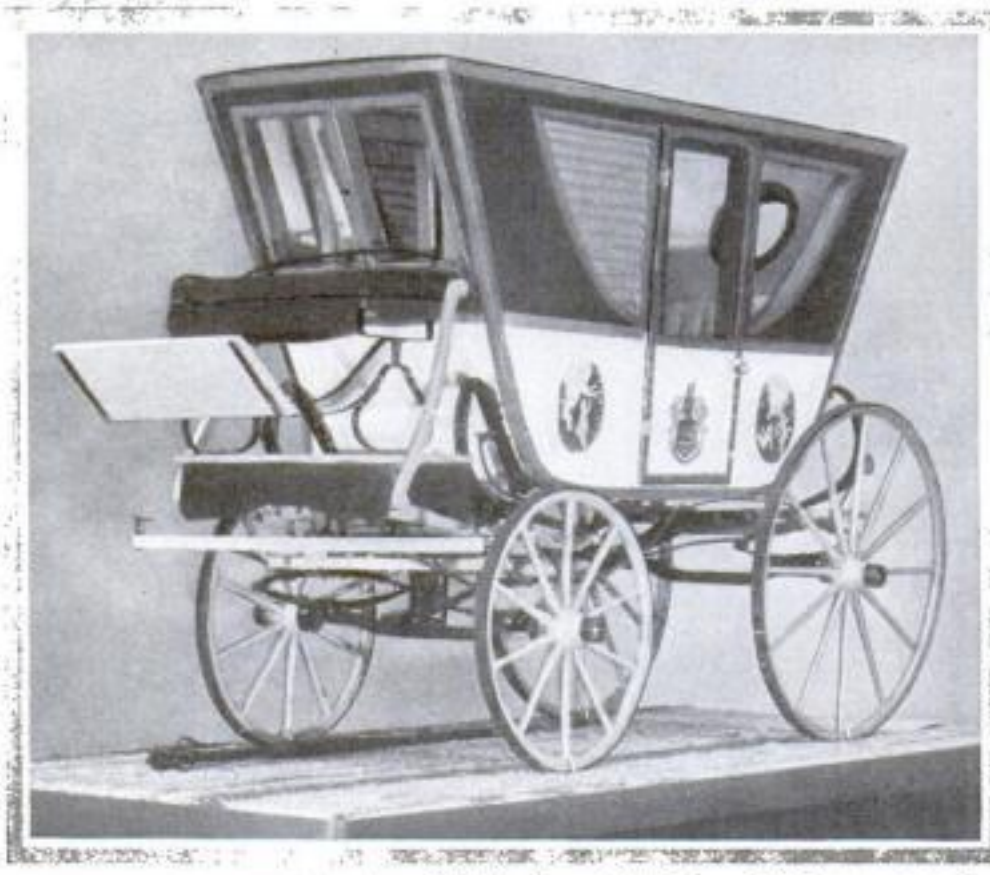


Two photographs of the first-prize model built by H. G. Bryant. His drawings are reproduced on the facing page

Third prize—a small model of Washington's inaugural coach made by Felix Sweins

The drawings are reproduced on the following page. In the few places where Mr. Bryant has inserted dimensions on the drawings, he has given the dimensions of the coach itself, not the model.

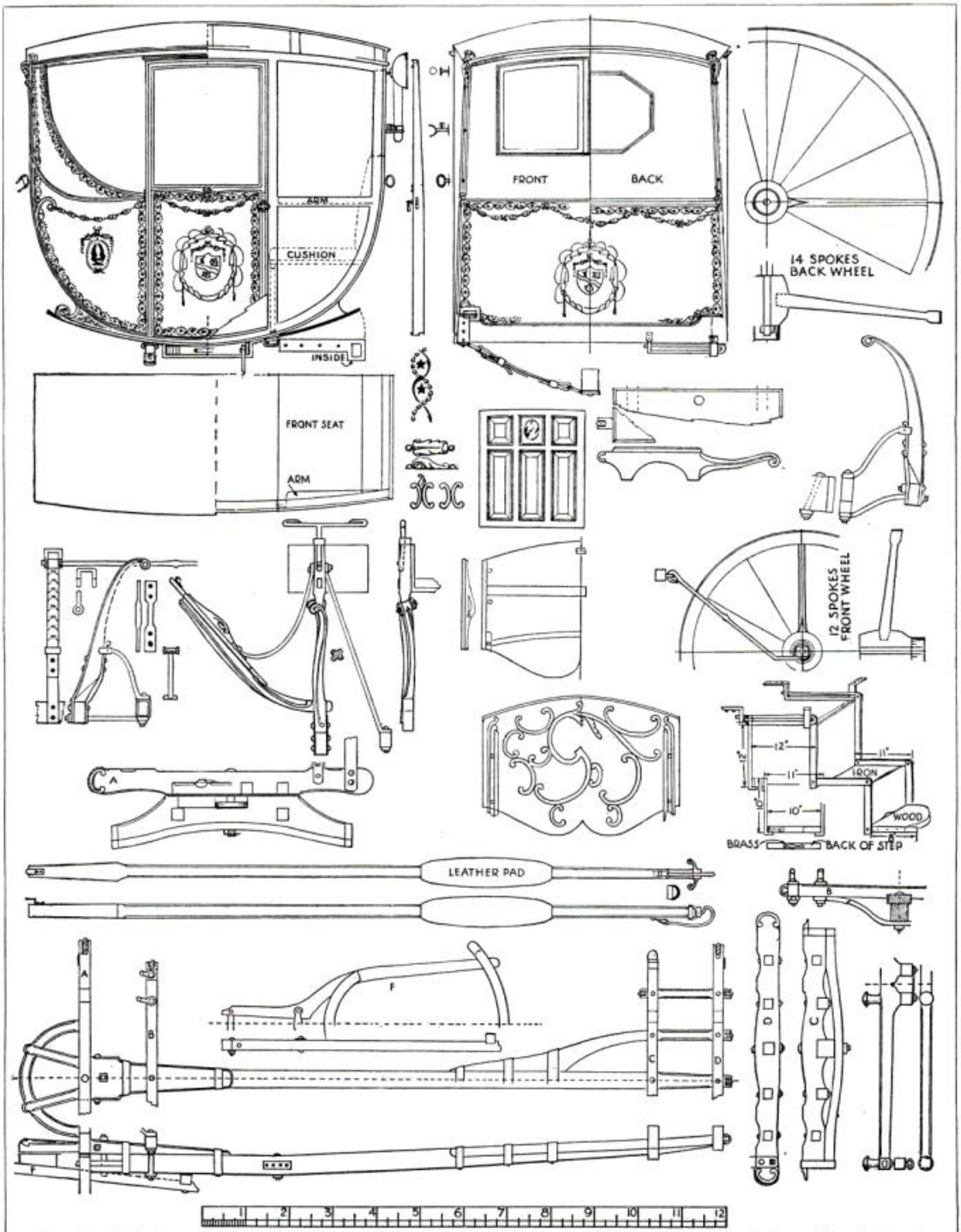
The wheels are pale yellow, the body is russet yellow except the curved spaces at each side of the top shuttered opening in the door and the upper part of the front and back ends, which are black. The top is also black. The decorations are dark blue, with red stars in the painted ornamentation around the door opening. All the carved work is gold. The small ovals have a red ground, a black eagle, and are outlined with a garland of pink roses and green leaves. The coat of arms is yellow with two red roses and a black figure. The field on which the shield is placed is blue with red and yellow drapery and a fine red line about it. The upholstery is white broadcloth, and the upholstery of the back of the rear seat is extended to the top of the coach.



This carefully detailed and well-finished model by Harry Bock won second prize. It is the inaugural coach built on a scale of ⅛ in. equals 1 in.

The second prize of $75 went to Harry Bock, of Manchester, Vt., for a model of Washington's inaugural coach which he built entirely from the information contained in the article published at the time the competition was announced (P. S. M., Aug. '32, p. 67). Felix Sweins, of Eureka, Calif., gained the third prize of $15 with a 1/16 in. scale model.

Colonial Coach Model



Drawings of the first-prize coach with a scale in inches from which the dimensions of the various parts of the model can be found

• *THE RIGHT WAY TO*

True Up Worn Drill Chucks

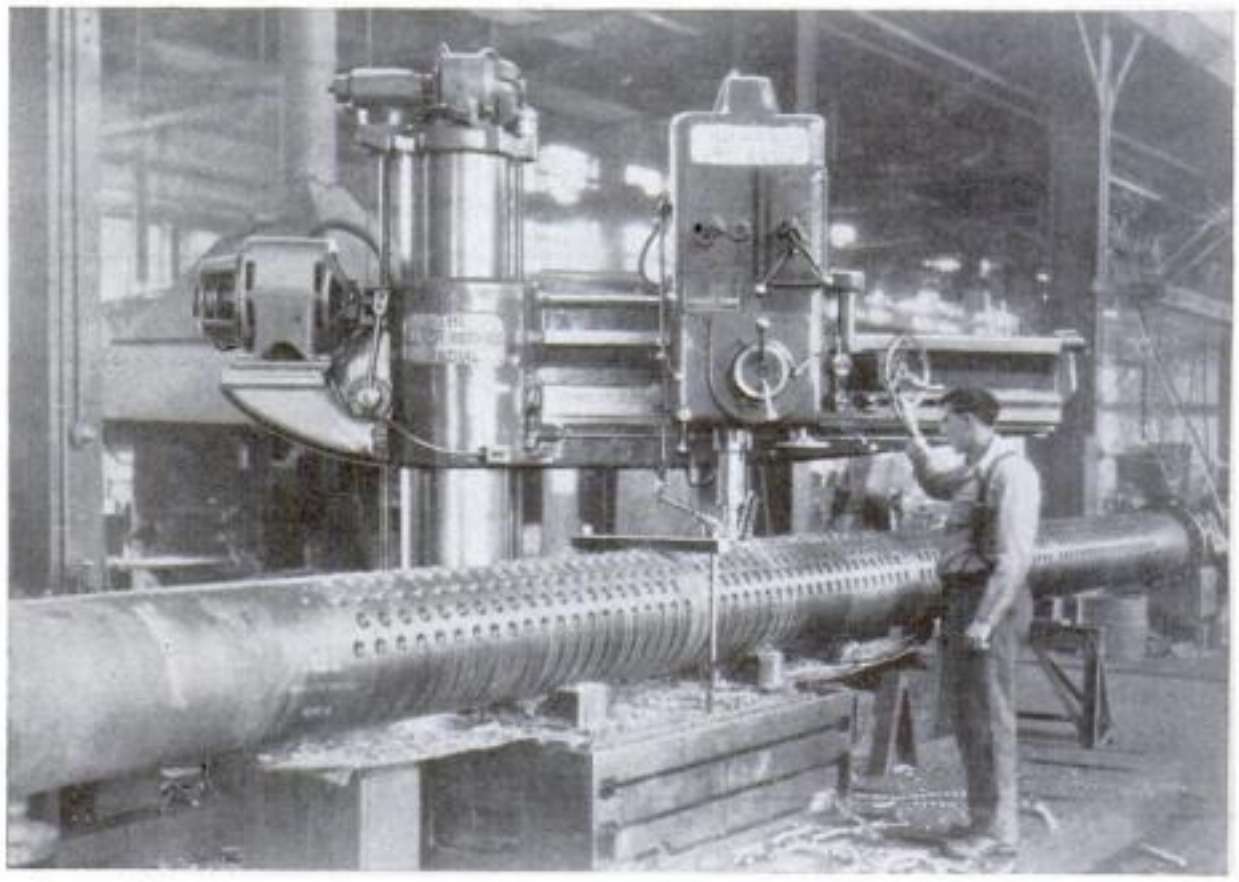
and other useful machine shop hints •

By HECTOR J. CHAMBERLAND

PRACTICALLY all medium and small upright and radial drills have standard chuck equipment of the type shown at *A* in the accompanying drawings. These chucks come in different sizes to take shanks or round stock up to 1 in. While they are mechanically well designed for long service, they are subject to much abuse through no fault of their own and thus are likely to become inaccurate.

In considering the care of the drill chuck, we shall also give some suggestions in this article on the upkeep of small drills under ½ in., or the so-called "wire" drills. The economical maintenance of larger drills was covered in a previous article (P. S. M., Nov. '32, p. 78).

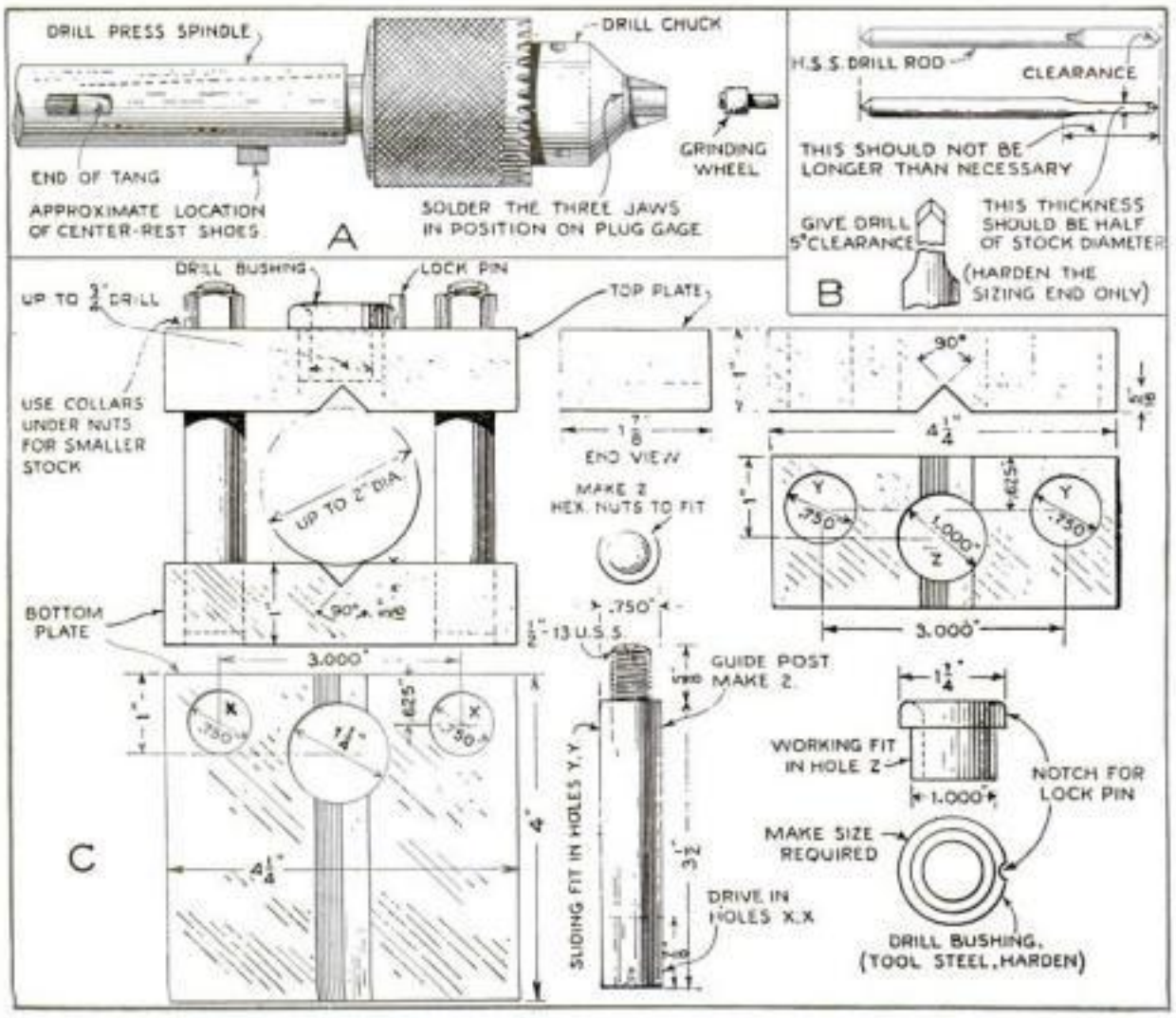
Let us see first what we can do about repairing the chuck. Every machinist knows the condition of the average wire drill shank; it is often so battered that it will cause the drill to run out and seriously damage the chuck. A bad trick practiced by many mechanics is this: if the drill shows any sign of being out of true, the operator will pick up anything handy and bang the drill right and left until it appears to spin all right. This carelessness results in a crooked drill and throws a strain on the chuck jaws. Eventually an overhauling is required to restore the concentricity of the chuck.



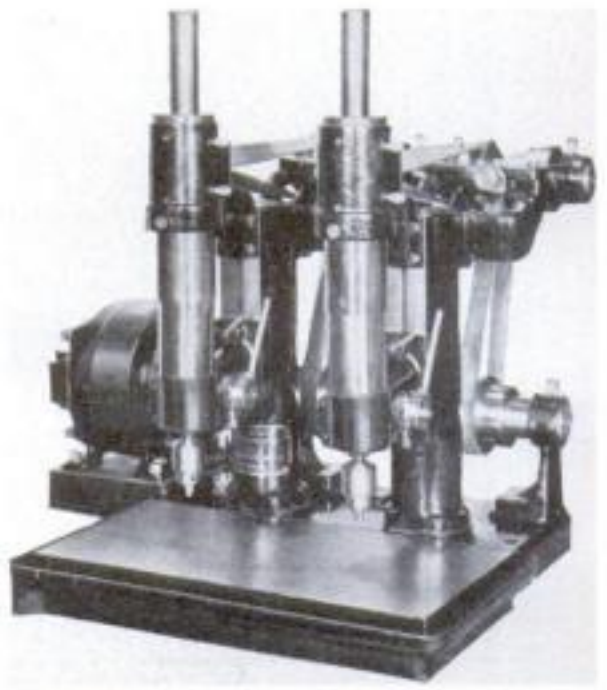
Successful drilling requires a properly ground drill point and absolute rigidity. In this case 412 holes 2 in. in diameter are being drilled in a steel header within limits of .02 in.

To make a good job of it, the spindle is removed from its bearing or sleeve so that the socket can be trued. The spindle is mounted in the usual way in the lathe or universal grinder, using the required taper plug gage to get the location of the steady rest. After setting for the correct Morse taper, remove just enough stock to true the bearing. It should indicate within .001 in. with the plug gage.

Once this operation is completed, the chuck is inserted in the socket for grinding the bearing surfaces of the jaws. The jaws must, of course, be ground in their gripping position; if not, all this time would be wasted. This is easily done by closing the three jaws on a plug gage of a diameter about two-thirds the capacity of the chuck and soldering them at the location indicated in drawing *A*. The jaws should be tightened lightly enough to allow the plug page to be pulled out.



How chuck jaws are soldered so that they can be ground *(A)*; a flat drill for finishing small holes *(B)*; and a simple fixture for drilling cross holes in stock up to 2 in. in diameter *(C)*



The other extreme. In drilling small holes the chuck deserves as much care as the drill

When the table has been set for a perfectly straight grinding job, the jaws are spotted until all show clean and free from marks. The solder is removed and the chuck shank is touched up on the cylindrical grinder by closing the jaws on a short piece of centered stock. Even with some wear in the ways of the sliding members, this complete repair job restores almost the original accuracy. Later, when the chuck jaws become completely worn out, they may, of course, be replaced at relatively small cost.

ONCE the spindle and chuck are in good condition, the problem is to hold the desired size with a small drill. It seems here that we must turn the bag inside out—after insisting on machine ground drills in our previous article, we find we have to depend on skillful hands and good vision for grinding the smaller sizes. There are machines to grind drills as small as ⅛ in., but they are not to be found in the average shop.

Unlike large drills, small ones should be point-ground on the face of the wheel instead of the side. Drills from 3/16 to ½ in. in size may be tested with the gage; for smaller sizes, a magnifying glass will help materially. With a few minutes' practice each day, any machinist can become quite proficient. When grinding a small drill, let the wrists govern the up-and-down movement and not the arms as a whole. If you assume the correct posture and once find the right spot on the wheel, you will soon become an expert. It is mainly a matter of painstaking care and persistent practice.

Many small drills break from poor grinding, but an equal number fail because of insufficient speed. A drill can be compared to a grinding wheel—the smaller the drill, the faster it must travel to resist the feed. Bear in mind, therefore, that too slow a speed is just as bad for a small drill as too fast a speed for a large one.

IT IS more often necessary to drill an accurate hole with a small drill than with large sizes, for the reason that it is impossible to keep in stock so many small reamers. A new wire drill, no matter how accurately sharpened, will cut at least .001 in. oversize. If a standard hole is essential, it will be necessary to reduce the length of the drill by about ½ in. Sometimes stoning .0005 in. from each lip will keep the hole within limits.

When a substantial number of holes have to be held to a plug gage, a good way is to use a twist drill the next size smaller and make a flat drill as shown at *B* for finishing the hole. If the dimension required is between standard sizes of drill rod, the rod may be turned and filed. This small tool is really an inexpensive reamer, but it will hold its size within surprisingly close limits.

Locating cross holes is a familiar operation in every shop. This can be done accurately in the milling machine, but it is not advisable to resort to the use of that machine except for regular jig and fixture work. For cross drilling, the device shown at *C* is a real timesaver. It operates on the idea of a die set and has a range up to 2 in. for stock and ¾ in. for the cross hole. Since it is made of machinery steel and not hardened except for the drill bushings, the device is inexpensive.

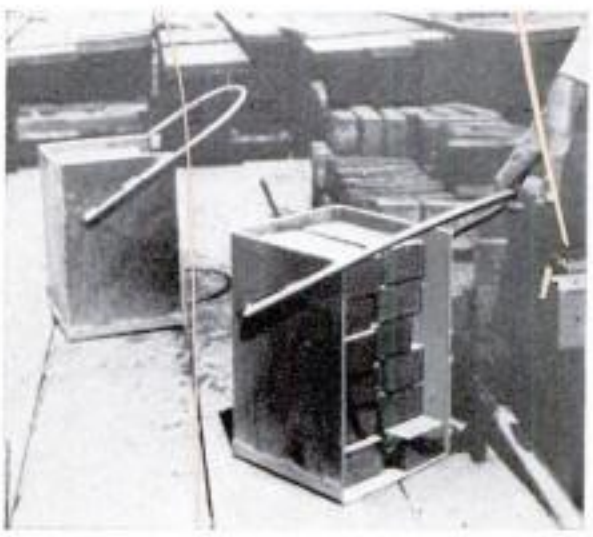
LABELING ROLLED-UP BLUEPRINTS

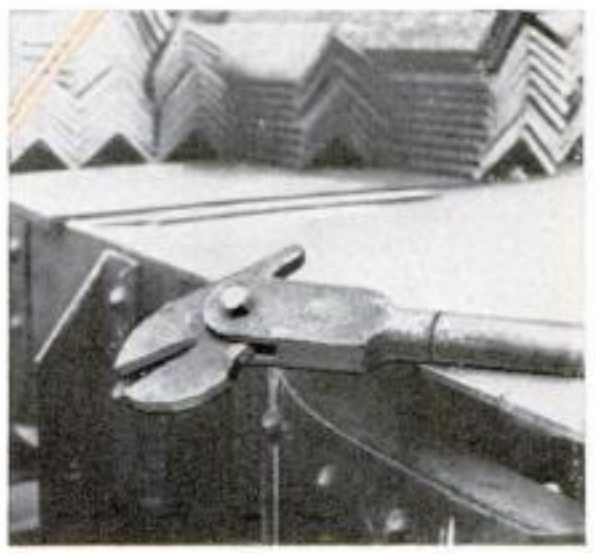
The labels project conspicuously from the rolls

BLUEPRINTS, tracings, and drawings which are kept rolled up are difficult to label in such a manner that, when two or more sheets are rolled together, some or all of the labels are not covered up. Hours have been wasted in every large shop and drafting room searching for lost sheets which have accidentally been rolled up with other unrelated blueprints or drawings. If, however, a label (which may be made of gummed paper tape) is affixed to each sheet so as to project stiffly from one edge as shown, it will be found impossible to roll up the sheet without having the tag remain in range of sight.—WILLIAM F. SAUNDERS, JR.

BRICKS LOWERED SAFELY IN WELDED METAL HOD

SAFE, easily handled hods for lowering brick into cesspools, sewers, and other openings below ground may be made as shown in the photograph below, from No. 10 gage metal and a length of ½-in. rod. A rectangular sheet is bent to form three sides of the hod, which is of a size to hold twelve bricks. A square sheet for the bottom is then slit about 1 in. at two corners, the edges being turned up that distance to lap over the end of the folded side sheet. The bottom is then securely tack-welded in place. The rod is bent and each end welded to the outside of the hod at an angle as indicated so that the bricks will not fall out when the hod is suspended at the end of a rope and lowered into the working space.—J. C. COYLE.





SPECIAL TURNING BAR FOR STEEL BEAMS

A BAR with a hinged jaw, like that illustrated above, will prevent accidents in turning heavy steel beams. For the sake of lightness, the bar itself may be of pipe. To the end of this is welded a fork or clevis, the jaws of which are ¼ by 2 in., or heavier if desired. Between the ends of these jaws is loosely riveted a section of ¾-in. steel plate with a gap cut in one end and with the other end projecting so as to catch against the solid heel of the clevis. The gap may be of any size needed, and may be corrugated and hardened to prevent slipping. A steel beam cannot be turned without placing the bar in proper position; it will then hold until the beam is overbalanced, when it will automatically release the flange over which it is placed.

Old Bill *Says* . . .

SMALL internal grinding wheels can be made from broken or discarded surface grinder wheels by drilling a hole with a round file and then dressing the fragment of abrasive with a diamond while in place on the spindle.

If you expect to obtain accuracy when cutting a gear, see that the teeth of the cutter are perfectly radial.

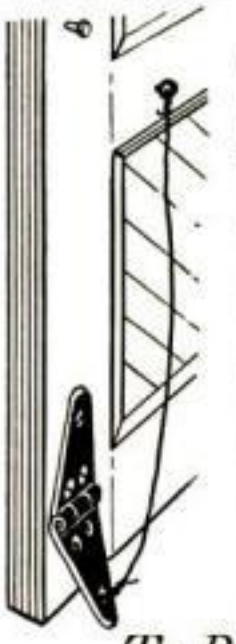
It is a good plan to use a little white or red lead on press fits. You may sometime have to press them out yourself!

Useful Kinks *for* Car Owners

Our Readers Supply Valuable Hints for All Who Work on Automobiles

IN RAINY weather or just after the car has been washed, closed-car window glasses often tend to stick and bind in the felt sash channels. This can be overcome by lowering the windows and greasing the guides with a small wedge shaved from a bar of white soap. The pointed end of the soap wedge is placed in the felt raceway and given a few strokes up and down, the full length of the channels. Unlike grease or oil, the white soap will not discolor or rot the felt.—A. J. H.

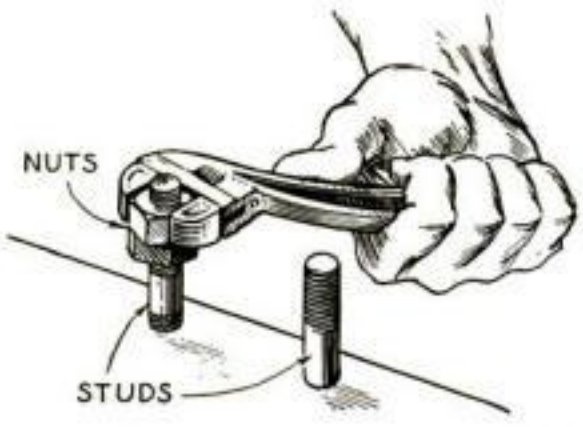
Hinges for Door Stops



ORDINARY strap hinges can be used as cheap and efficient stops for swinging garage doors. As shown in the drawing, the hinge is placed so that the short leaf drops far enough below the lower edge of the door to catch in the ground or surface of the driveway. The flexible wire lift serves to hold the hinge leaf out of the way when it is not in use and also permits lowering the stop without reaching or stooping.—K. C.

To Remove Studs

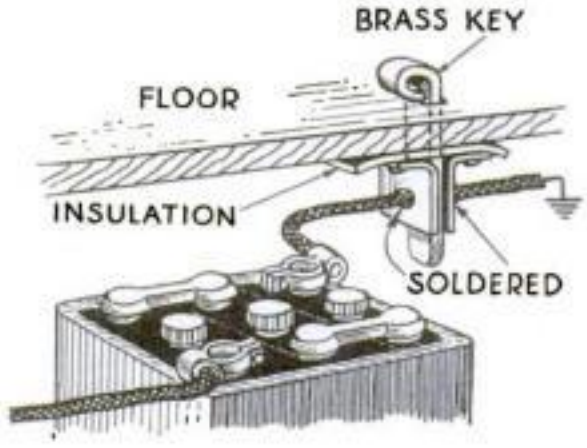
BY LOCKING two nuts on a stud, you can replace it or remove it easily with an ordinary wrench. First, screw two nuts on the stud and lock them, one against the other, by using two wrenches. Then turn the lower nut to remove the stud or the upper nut in the reverse direction to replace it. One nut serves as a locking nut for the other in both operations. To remove the nuts, simply unlock them by placing a wrench on each and turning them in opposite directions.—H. F.



By placing a wrench on one of two nuts locked together, studs can be removed or replaced

Mirror Reduces Danger

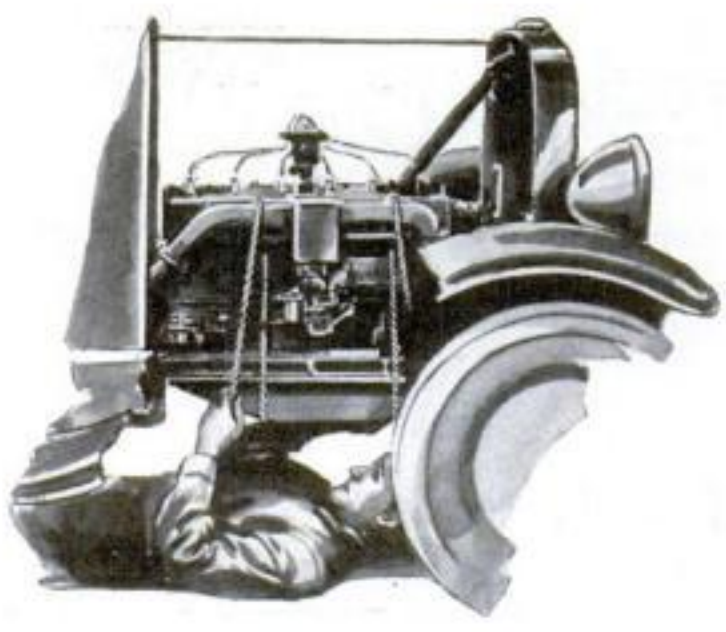
A MEDIUM-SIZED mirror, mounted on a pole outside of a blind driveway and adjusted to reflect the main road, is good insurance against accidents. When carefully adjusted, the mirror will give the driver of a car leaving the driveway a full view of the blind road in spite of fences, trees, and bushes that otherwise obstruct the view. If the drive enters the road at right angles, a mirror can be placed on each side. When a car reaches a certain point on the drive, a quick glance at each mirror will tell the driver the condition of the traffic in both directions.—G. E. K.



Hidden Lock in Car to Thwart Thieves

AS AN added protection against thieves, you can equip your car with the simple hidden lock as shown above. The lock consists of a short strip of brass that completes the battery ground connection when it is pushed through a small rectangular hole in the floor boards under the driver's seat. Cut the ground cable in two and solder a one inch square of sheet copper to each end. These terminals are then fastened in place under the floor boards on each side of the key hole. A piece of inner tube should be used to insulate the terminals from the floor board. When the key is in place the ground circuit is complete but when the key is withdrawn no power can be obtained from the battery. While the metal contacts under the floor boards should be sufficient springy to grip the key tightly, they should not touch when the key is removed. Of course, this switch will control the entire electrical system, including light.—R. S.

Putting a Crankcase Back in Place



THE JOB of putting a heavy crankcase back into place can be made a simple one-man affair by rigging a length of rope as shown at the left. One end of the rope is fastened to the frame of the car on one side and then placed under the crankcase. The other end is looped over the manifold on the opposite side of the engine and provides a simple pulley arrangement for lifting the crankcase. One hand can be used to pull the rope while the other is free to start the bolts. If the crankcase is long, two ropes can be used, one being placed at each end.—W. H.

THIS NEW TIRE WILL SAVE LIVES

Remarkable new invention makes safest tire ever built 3 times safer from blow-outs

No extra cost to public

THIS is probably the most vital single announcement ever made about a tire. It's the story of an amazing invention that will save thousands of lives . . . maybe *your* life . . . and prevent thousands of those accidents that maim and cripple people.

Today's high speeds—40, 50, 60 and 70—cause terrific heat inside the tire. Rubber and fabric begin to separate. A blister starts . . . and grows bigger and bigger. Then suddenly . . . BANG! A blow-out! A terrible drag sets in . . . you can't steer . . . and then smash!

To protect you from blow-outs every new Goodrich Safety Silvertown Tire has the amazing new Life-Saver Golden Ply. This new invention resists terrific heat. Fabric and rubber don't separate. Thus blisters don't form inside the tire. Blow-outs are prevented before they even start.

Safer at high speeds

At gruelling speeds on the world's fastest track, the new Goodrich Safety Silvertown, with Life-Saver Golden Ply lasted *three times as long* as first quality tires that did not have this feature. These SILVERTOWNS *never* blew. They were run until the tread was gone—but the Life-Saver Golden Ply *refused* to give!

Safest anti-skid tread

The tread, too, is safer from skidding. Even on wet, slippery pavements, the squeegee drying action of this famous tread gives your car extra road-grip and reduces danger of skidding to the minimum.

Put this Silvertown Tire on *your* car. Look up your Goodrich dealer's name under the classification "Tires" in your classified telephone directory. Put *real* protection between you and the highway.

FREE This handsome Safety League emblem with red crystal reflector to protect you if your tail light goes out. No obligation. Just join the Silvertown Safety League. Traffic Officials endorse Safety League membership. Write today. Dept. 155, The B. F. Goodrich Rubber Co., Akron, Ohio.

The **NEW**

Goodrich *Safety* Silvertown

WITH LIFE-SAVER GOLDEN PLY

Better *Snapshots*

AND HOW TO TAKE THEM

Simple ways to avoid getting them too contrasty or too flat and shadowless

By Frederick D. Ryder, Jr.

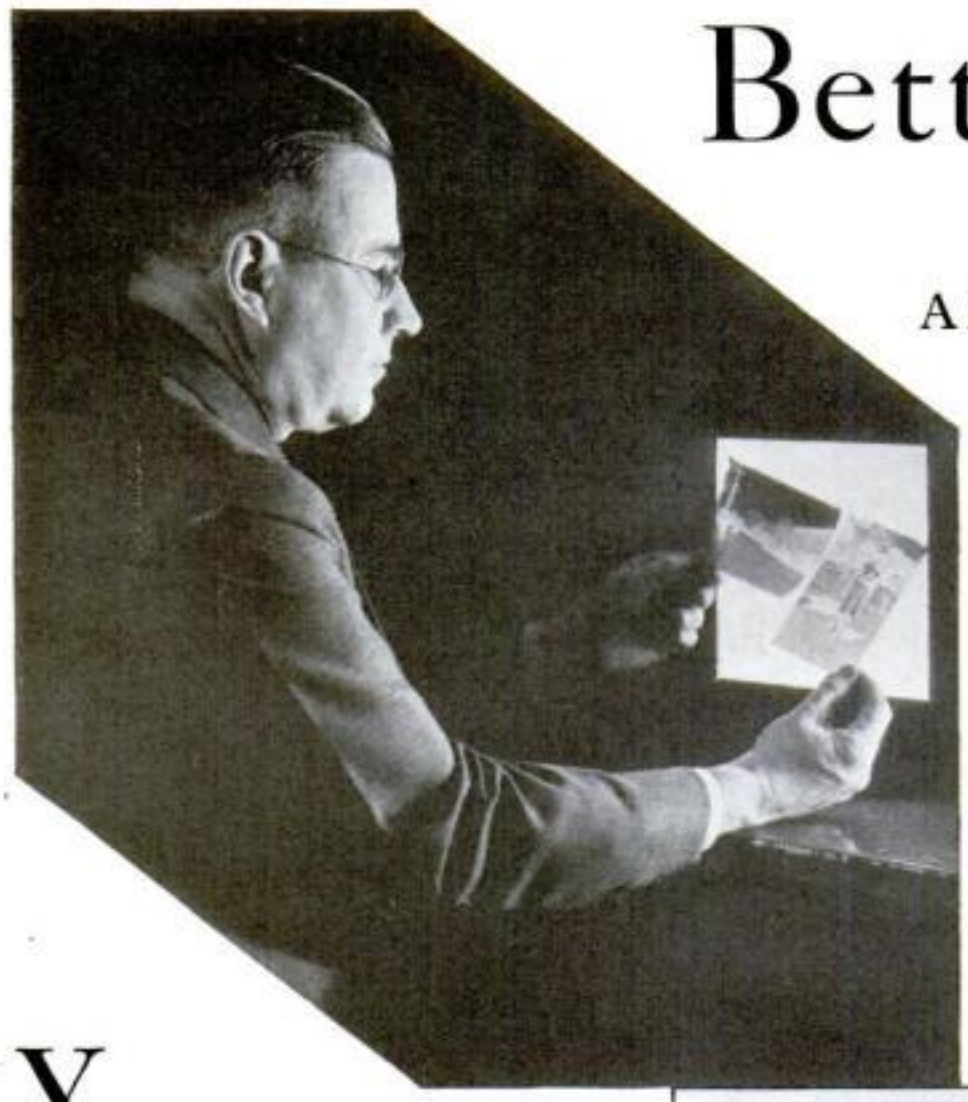


Fig. 1. A negative can usually be saved by aftertreatment if you can see the details in the clear portions when it is held before an illuminated ground glass or the sky

"YOU have talked quite often about how important it is to get the lighting right if you want good, clear, snappy photographs," writes a POPULAR SCIENCE MONTHLY reader, "and your instructions have helped me on indoor and outdoor pictures, too, when I had time to wait for the sun to get in the right position. But what I want to know is how to get better results on ordinary snapshots—the kind where you take the light as it is or go without a picture."

The answer is all a matter of learning how to control the range of contrasts in your photographs, or, in other words, to adjust the relative intensity of the light and dark areas of the picture.

If you get harsh, black and white pictures—Fig. 2 is a typical example—several things may be wrong. First, the exposure you gave when you took the picture may have been too short. Second, the film may have been developed too long in normal developer, in developer that was too strong, or in normal developer that was too warm. Third, the negative may have been printed on extra hard, or contrast, paper.

An extremely important point, too, is that these errors are cumulative. No serious error was made in taking or processing the picture of Fig. 2. It was only a trifle underexposed, the developer was only a little too warm (four degrees, in fact), the *(Continued on page 79)*

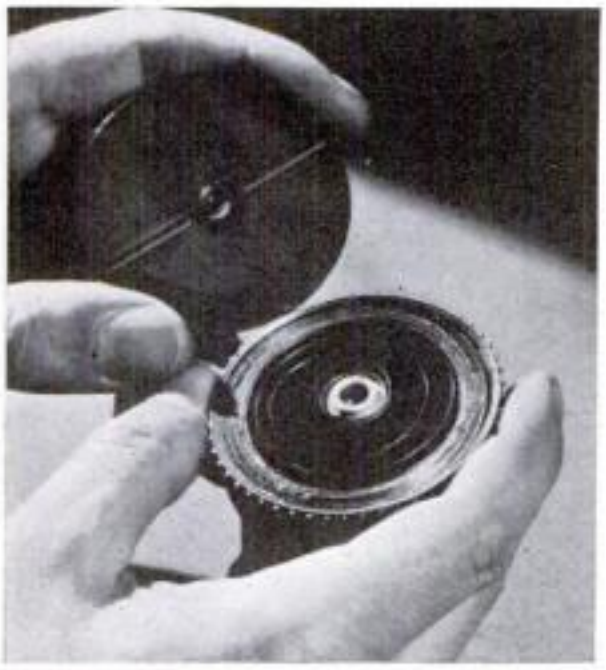
Figs. 2 and 3. Slight errors in the picture at the left give it the appearance of soot and whitewash. The other view (Fig. 3) shows how it looks when properly taken and finished

Fig. 4. Many views taken on dull days turn out flat and uninteresting. This one was a trifle overexposed, then developed too fast in slightly chilled and stale developer, and printed on soft paper

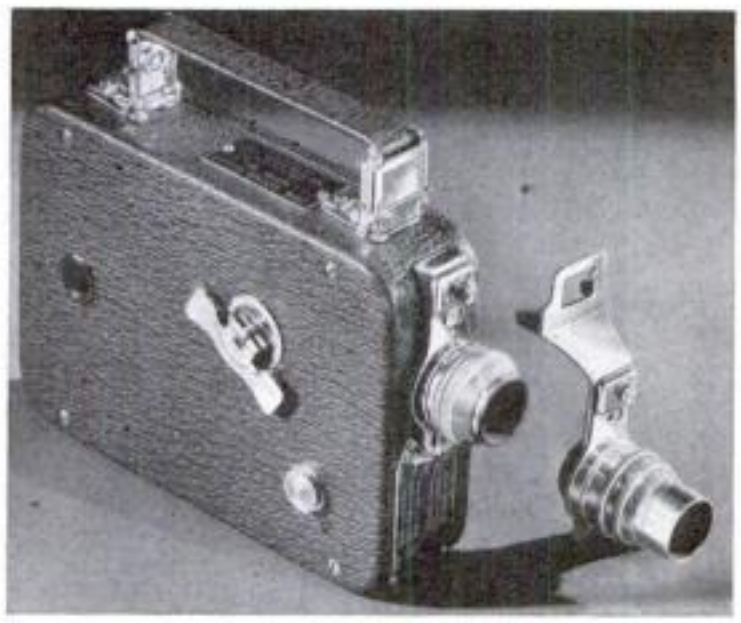
Fig. 5. This is the same scene, but the slight technical errors which ruined Fig. 4 have been corrected. The print was made on a more contrasty paper to compensate for the dead, flat lighting

EASTMAN NEWS BULLETIN FOR THE AMATEUR PHOTOGRAPHER

MAY, 1933, PUBLISHED BY EASTMAN KODAK COMPANY

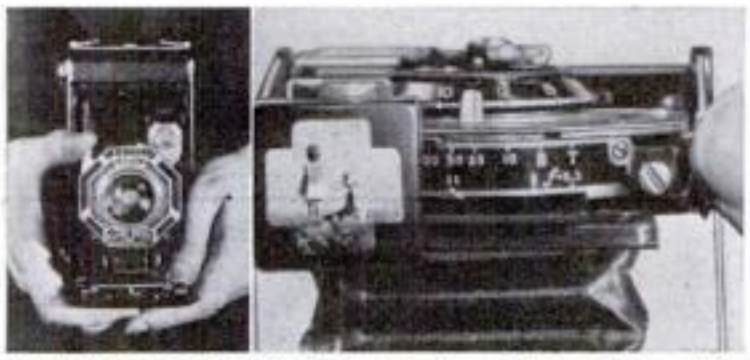


SPERM OIL COSTS 100 TIMES AS MUCH as the oil ordinarily used in movie cameras, yet the driving spring in the new Ciné-Kodak Eight is cased and sealed in this expensive oil—an instance of the extreme care to insure long life and perfect operation of your camera. Note the sprocket teeth on the spring casing. Ingenious telescoping of the spring in the drive wheel allows the use of the largest possible motor.

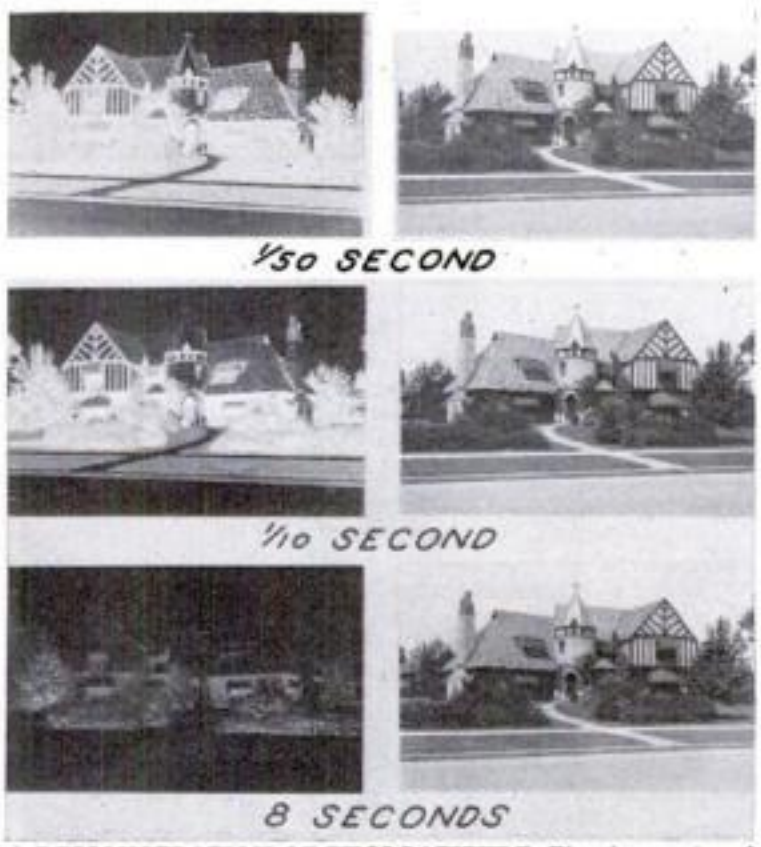


NEW CINÉ-KODAK EIGHT WITH ULTRA-FAST LENS. For those who desire the utmost in 8 millimeter movie-making possibilities—Ciné-Kodak Eight, Model 60, is the answer. Its *f*.1.9 lens is as fast as those on the finest 16 mm. Ciné-Kodaks, and focuses critically sharp from 2 feet to infinity. Instantly interchangeable with the regular lens is an *f*.4.5 telephoto lens. Model 60, with case, $79.50. Telephoto lens extra, $37.50.

SCREEN PICTURES 30,000 TIMES the area of the tiny 8 mm. film images are still clear and brilliant when projected with the Kodascope Eight, Model 60, which gives illumination adequate for a screen 22 x 30 inches. This fine projector has a lamp rheostat, automatic room-light switch, high-speed automatic rewind and still-picture device. Price, $75, with carrying case.



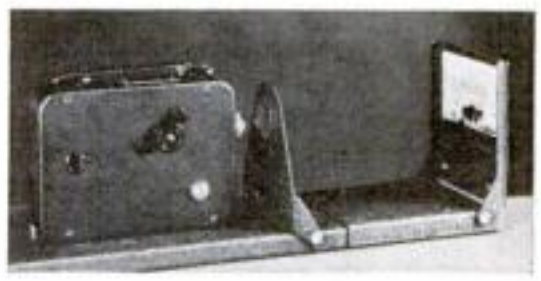
WITHOUT CHANGING the camera from picture-taking position you can adjust the focus and choose the shutter speed of the Kodak Six-16, by means of the secondary shutter and distance scales on top of the camera. See this new Kodak at your dealer's. It has all the features that make fine picture making easiest.



A DEMONSTRATION OF FILM LATITUDE. The three pairs of negatives and prints above show the amazing exposure latitude of Kodak Verichrome Film. Although the second negative was given 5 times and the third 400 times as much exposure as the first, all three made satisfactory prints. This extraordinary exposure range is one reason why amateurs get better pictures on Verichrome Film.

If it isn't an Eastman, it isn't a Kodak

CINÉ-KODAK EIGHT TITLER. With this simple device you can make regular or trick titles from typed or lettered cards, snapshots, magazine illustrations, etc. Use the film occasionally left over in your camera to keep your titling up-to-date. Titler adjustable to either 16 mm. or 8 mm. Ciné-Kodak. Complete with 100 blank title cards, $6.50. Send for booklet below for a description of other editing equipment.



LONG BELLOWS BRINGS SUBJECTS CLOSER. How Kodak Recomar close-ups compare with ordinary camera close-ups is shown in the toy-dog pictures above at the right. The Recomar with its long bellows can show small objects up to natural size using its regular lens. Its extra bellows length also permits the use of inexpensive auxiliary lenses to bring distant subjects closer. With an auxiliary short-focus lens, the Recomar will take an extremely wide-angle view or show small objects almost twice natural size. Kodak Recomar 18 (2¼ x 3¼), $40; Recomar 33 (3¼ x 4¼), $48. Supplementary lenses, $3.50 each. Send coupon for further details about this versatile camera.

SEND COUPON FOR THESE FREE BOOKLETS

P. S. 5-33

Eastman Kodak Company, Rochester, N. Y.

Please send me free booklets on subjects checked below.

☐ Ciné-Kodak Eight Equipment

☐ Kodak Six-16

☐ Kodak Recomar

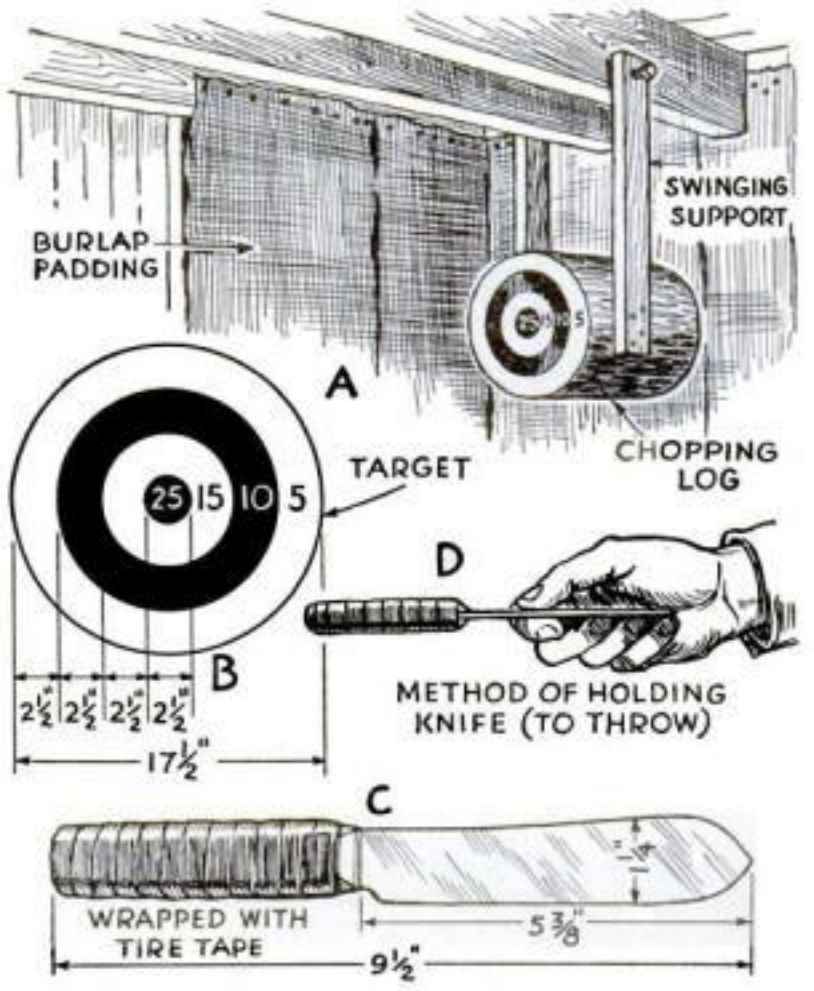
Name.....

Street.....

City.....State.....

Throwing Knives at Target Is Novel Sport

Each contestant throws three knives at a time and adds up the points



How the target and knives are prepared. The blades are well blunted so that there is no danger of getting a cut

KNIFE throwing is an inexpensive, exciting game of skill in which all ages and both sexes can participate. It has something of the novelty and thrill of the circus and never gets monotonous. The equipment can be set up in the cellar in an evening. It consists of an old chopping block, three knives (ours cost 19 cents each), a small roll of tire tape, rag bags, two boards, nails, and a little paint. The total cost is less than a dollar.

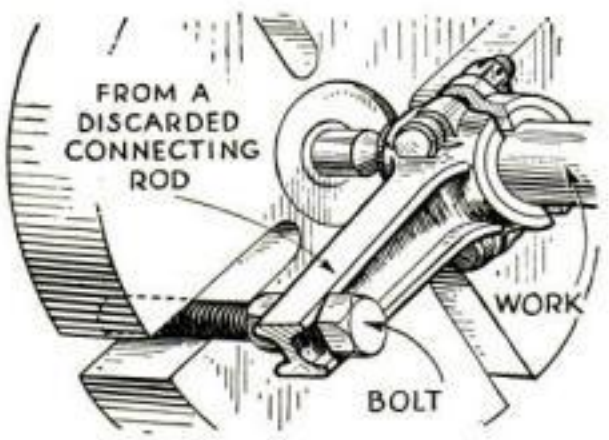
The target *A* is a block of wood without knots, 17½ in. in diameter and about 15 in. long. Soft pine is best. Saw the face smooth across grain so that knives can enter with the grain. Paint rings as shown at *B*. Attach a board midway from each end on either side, and hang on joists about 52 in. from the floor in such a way that the block can swing back and forth.

About 1 ft. behind and, if necessary, to the left and right, tack up rag bags to stop knives and prevent their damage. Lay rough boards loosely on the cement floor, under and in front of target. Cover these with rag bags or old carpets.

An ordinary butcher's knife will serve the purpose. Grind to the shape shown at *C* for balance, and wrap the handle with tire tape to hold the rivets. Grind and round off the cutting edge up to within about ½ in. of the point and file the point to a blunt, chisel-like edge that is not sharp enough at any place to cut the hand. This is important. Experience has shown that although this makes the game safe, it does not interfere with the penetration of th: knife. Not one of all who have thrown these knives has ever received even the slightest injury.

The position of the knife in the right hand is shown at *D*. This gives a firm, steady grip. Stand facing the target 12 ft. from it, knife in hand. With arm over head, elbow bent slightly, swing arm at shoulder foreward and downward.

After throwing three knives, we count score, remove them from target or floor, and throw them again until we have thrown 21 knives in 7 sets of 3 each. The accumulated total thus gained is our score. A doubtful knife in the target is measured across its width at the surface of the target. The greatest width in either ring decides the issue, and one exactly half and half is counted on the lower score. Only knives in the target after the third has been thrown are counted. Variations in knives, knife holds, distance from target, and other conditions will quickly suggest themselves.—W. W.



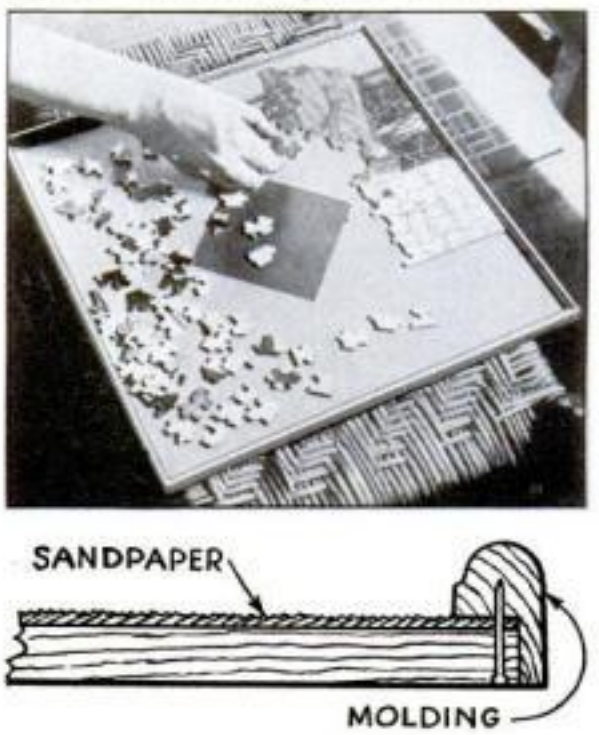
IMPROVISED LATHE DOG

A LATHE dog can be improvised from an old model-T Ford connecting rod. It may be applied to work from ¾ to 1½ in. in diameter, a narrow leather strap being used to bush up small work. One advantage is that the Babbitt metal will not injure threads. The cut-off end of the rod is drilled with a ⅜-in. hole, as shown above, for a bolt.—EARLE STRAND.

BOARD AIDS IN ASSEMBLING PUZZLES

PICTURE puzzles, especially those made of cardboard, can be solved much easier on a board that is covered with fine sandpaper, blotting paper, or other nonskid substance and that has a rim projecting slightly above the top. The rough surface prevents the puzzle pieces from slipping, and the strips form a framework for keeping the puzzle square.

To make such a board, obtain a piece of thin wood, preferably plywood, about ¼ by 15 by 15 in. Cut strips measuring about ⅜ in. one way, and fasten them along the edges so that ⅛ in. projects above the board surface. If you have a shaper or molding cutter, you can make the strips into an attractive form. If sandpaper is to be glued on the board, the No. 00 grade is about right. By employing ordinary sandpaper pieces in combination with a darker variety, you can work out an attractive design.—ROY ELTON.



BETTER SNAPSHOTS

(Continued from page 76)

time was prolonged only a few minutes, and the grade of paper in this particular case was identical with that used to print the picture of Fig. 3, which is the same shot without the errors.

So much for sunny pictures. Now look at Fig. 4. Here is an ordinary street scene taken on a dull, cloudy day in the early afternoon. It was slightly overexposed and developed in developer that was a bit weak (it was slightly stale). The solution was, unfortunately, about three degrees too cold, and the film was yanked out a minute or two sooner than it should have been. Paper one grade on the soft side was used for the print. And what a print! Nobody could call this one a satisfactory result.

THE same street view with the technical errors corrected appears in Fig. 5. In this case, however, a more contrasty paper was used to make up for the dead, flat lighting of the cloudy day.

Modern film, such as verichrome, has great latitude and therefore permits considerable variation from correct exposure without spoiling the picture, but you can't expect detail in the shadows (the eyes in Fig. 2, for example) unless the exposure is long enough for the film to record them.

Fortunately for all of us, the errors we may make in taking pictures and in finishing them, or our photofinisher may make for us, are just as likely to balance out as they are to work all one way. For example, Fig. 2 would hardly have been distinguishable from Fig. 3 if it had been developed too long in normally strong developer and the solution had been somewhat too cold, and then it had been printed on extra soft paper.

Since none of us has yet reached the infallible stage and even the best of photofinishers slip once in a while, the next question is, what's to be done about sunshine pictures that turn out too contrasty and cloudy day views that are too flat?

Obviously, the first step is to examine the negative to see if the print has done it full justice. As a general rule, all very contrasty negatives, when held in front of an illuminated ground glass as in Fig. 1 or against the sky, look fine. The eye sees detail in the shadows, which are the light portions of the negative, and does not notice the great differences between the light and dark portions of the negative.

IF THE negative shows practically clear film in most of the light portions, in other words if the details of the face cannot be seen even in the negative, then the underexposure has been too severe and the picture will have to be retaken. If, however, detail can be seen at all points in the negative and the only difficulty seems to be too great contrast, reduction, either chemically or by reversal, will give you a satisfactory print. Naturally, before this work is undertaken, make sure that the print has actually been made on the softest paper available. Often the use of a soft printing paper will give you a good picture from a negative that seems hopelessly contrasty on the normal or hard grades.

In the case of a too flat picture, such as Fig. 4, the first step is to try printing on a hard grade of paper. This is worth while if the negative shows detail in all parts and the only difficulty seems to be the all-pervading grayness. If the contrasty grade of paper effects an improvement, but the picture still is too flat, intensification can be tried. This is a simple chemical process which I need not detail. Anyone can follow the simple directions on the (Continued on page 81)

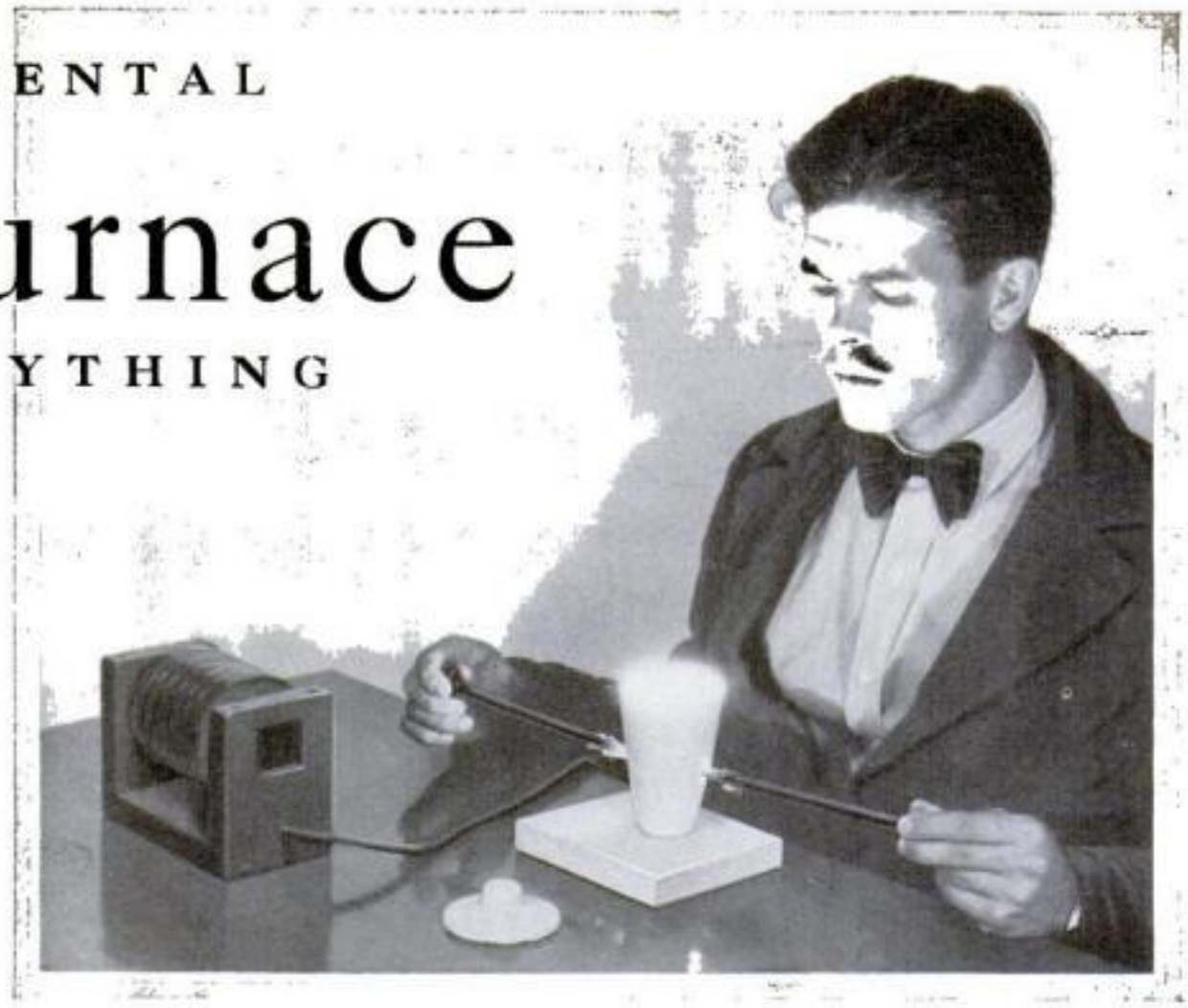
EXPERIMENTAL

Arc Furnace

MELTS ANYTHING

How to wind a simple coil reactance that controls the current, protects the fuses, and cuts down greatly the cost of the electric power

By Alfred P. Lane



Operating a small arc furnace with a reactance that is as effective as two 600-watt electric grills connected in parallel. It is practically as serviceable as a step-down transformer

HEAT so terrific that no known substance is able to withstand it for long can be developed in your home laboratory with nothing more than a pair of electric light carbons, a small crucible, and some means of controlling the flow of the electric current from the house mains through the arc.

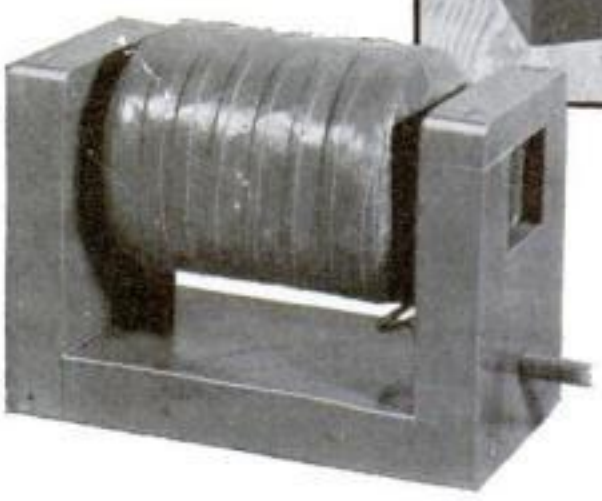
Most electrical experimenters attempt to use an old toaster or electric grill in series with the arc. This works all right, but the current flow is limited to three or four amperes and is greatest when the carbons are in contact and the arc is producing the least amount of heat. Adding another toaster or grill in parallel with the first one doubles the current through the arc, doubles the cost of operation, and still is open to the objection that the current flow is greatest when the arc is least effective.

The difficulty is that a carbon arc, operating on the ordinary 60-cycle, 110-volt current, actually requires only about 35 volts. The difference is wasted in useless heat from the grill or toaster.

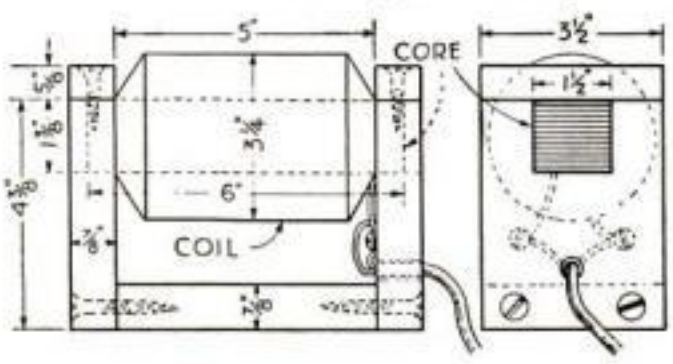
You can avoid such troubles by building a current limiting reactance to take the place of the makeshift resistances. The reactance upsets the power factor of the line in such a way that the current flowing through the arc actually is in the neighborhood of 10 amperes although the meter runs only as fast as though 3½ amperes were flowing.

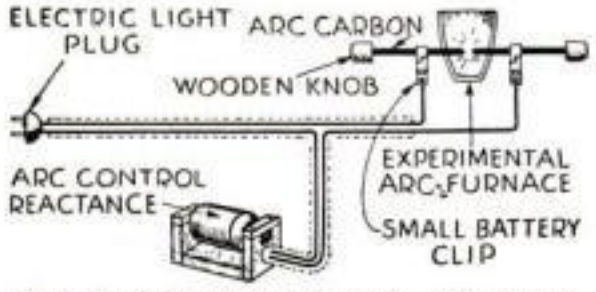
The homemade reactance shown was designed especially for amateur arc furnace experiments. The core is made of transformer steel laminations or annealed iron strips measuring 1½ by 6 in. Enough of them are used to make the core 1⅜ in. thick.

After the core has been tightly wound with four or five layers of friction tape, the winding can be started. Use No. 12 enameled, cotton covered wire. The first layer should be 5 in. long, and the end of each succeeding layer should be stepped back half the width of the wire. This gives a cone-shaped effect and avoids the use of retaining disks. Continue winding till the outside of the coil measures 3¼ in. in diameter. Then apply several layers of friction tape to protect the winding and keep it from coming loose at the ends.



Two views of the coil and a drawing that gives the dimensions of the parts. The core must be clamped down firmly





How the connections are made. No current can flow without passing through the coil

Be sure that the notches in the upright end pieces of the wooden frame are slightly less than 1⅜ in. deep so that the toppieces will clamp firmly on the ends of the core.

Connections are made to the coil by drilling a hole in the upright, passing the end of a flexible cord through it, and soldering the coil end wires to the bared ends of the cord. A soldered loop should be formed in each wire so they may be firmly clamped to the inside of the upright by means of small, roundheaded wood screws.

After the reactance is finished, give it a coat of black paint or lacquer.

A handy wiring harness for arc experiments is suggested in the diagram above. The metal or other substance to be melted can be placed in a smaller crucible suspended within the outer one. Obviously, any desired type of furnace may be built to suit the work. Bear in mind, however, that the heat is intense enough to melt iron and porcelain and must be cautiously used. Do not look directly at the arc without wearing goggles.

This reactance is for use only on 60-cycle, 110-volt A. C. current.

BETTER SNAPSHOTS

(Continued from page 79)

packages of the prepared intensifiers which are to be had at any photo supply store.

Reversal also does the trick if process cut film or plates are used. Reversal, either to intensify or reduce the contrast, is exactly the same process. It is carried out by making a contact print from the original negative, using a plate or cut film instead of the usual printing paper. After this positive is developed, fixed, washed and dried, another plate or cut film is taken from the box and is printed from the newly made positive. Developing, fixing, washing, and drying this second plate or cut film gives you a new negative. If you use strong developer and process film, the new negative will have much more contrast than the original. If you use commercial plates or cut film and weak developer, the resulting new negative will have less contrast than the original. The reversal process can, therefore, be made to give any kind of a new negative you want. Furthermore, the original negative is not altered or harmed in any way.

In any case, no scheme of after treatment is worth the trouble if it is reasonably easy to take the picture over again.

The whole matter of getting the right contrast can be summed up in a few words. Make sure that you give a full exposure on all sunlight pictures. When the lighting is exceedingly harsh, it is better to double the exposure recommended by the exposure tables than to take a chance on excessive contrast. Keep the exposure on the low side on all pictures where the lighting is soft and without heavy shadows.

If you do your own photofinishing, standardize your process throughout.

Prizes Awarded for Christmas Photos

PRIZES have been awarded as follows in the third of our $100 photo contests (P.S.M., Jan. '33, p. 72), which was on the subject of indoor Christmas pictures:

FIRST PRIZE, $50
Charles J. Belden, Pitchfork, Wyo.

SECOND PRIZE, $25
W. Keibel, West Allis, Wisc.

THIRD PRIZE, $10
Mary Dierdorff, Pasadena, Calif.

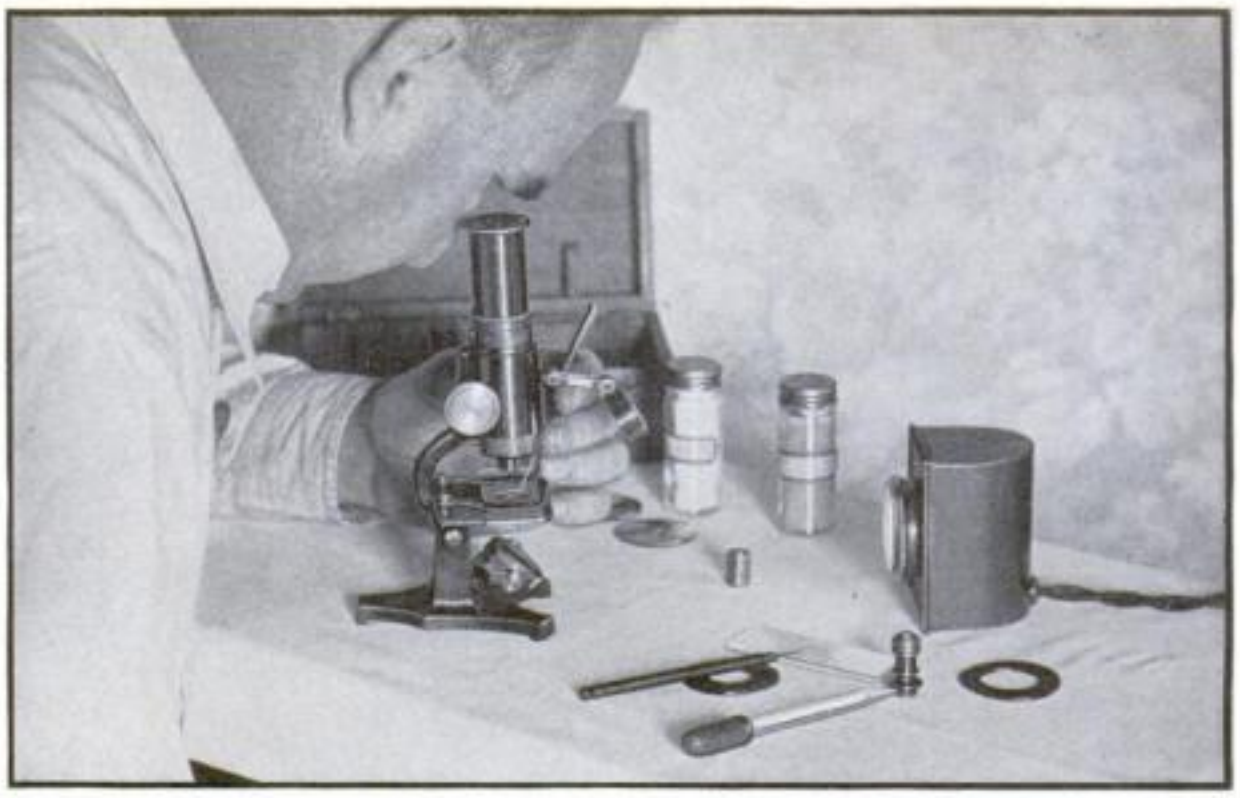
FOURTH PRIZE, $5
S. Beliaeff, Bloomfield, N. J.

FIFTH PRIZE, $5
Holger H. Van Aller, Saratoga Springs, N. Y.

SIXTH PRIZE, $5
William H. Evans, Huntington Park, Calif.

HONORABLE MENTION—*Louise Price Bell, Akron, N. Y.; Harold Begler, Canton, Ohio; Ana Forbringer, Summit, N. J.; R. L. Harmon, St. Paul, Minn.; E. L. Knapp, Lawrenceville, Pa.; Herman G. Muelke, Buffalo, N. Y.; John S. Wheeler, Woonsocket, R. I.; Roy E. Young, San Angelo, Tex.; and Samuel Paul Zito, Niagara Falls, N. Y.*

The winners of the February contest will be announced next month.



Studying a specimen in the illumination of an adjustable homemade lamp. It has a lens cell that allows various glasses and diaphragms to be used to regulate the light

HIGH-GRADE

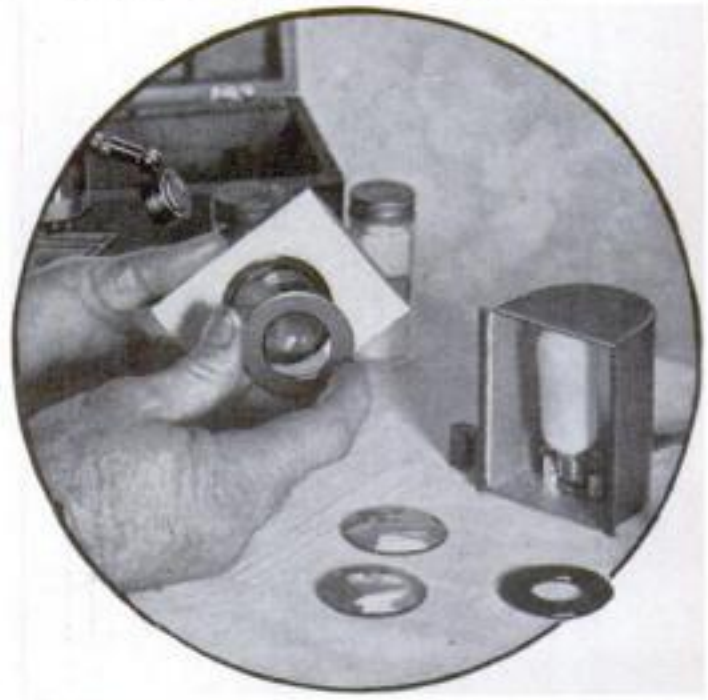
Microscope Lamp

BUILT AT LOW COST

THE professional microscopist considers his light nearly equivalent in importance to the lenses he uses in his instrument, and chooses and adjusts it with equal care and discrimination. The amateur or student soon learns how essential it is to have a reliable and definitely controllable source of light for his work. Too strong a light invariably leads to headache and eyestrain; insufficient illumination is simply out of the question.

The accompanying photographs illustrate the construction of a practical microscope lamp which the average amateur craftsman can build for himself at little or no expense. The materials are such as may usually be found about the house.

The body of the lamp shown is 3¼ in. high by 2⅝ in. wide over all. It was formed from a small piece of thin sheet metal, with a groove or channel at either side to receive the front panel, or door, containing the lens cell, which is shown in the circle.



The lamp in its housing and the front panel which carries the cell for holding glasses and diaphragms

The lens cell complete, including both outer and inner threads, was cut from the front end of a flash light. The shallow compartment, or pocket, formed by the depth of the threaded portion provides the cell for the reception of a variety of lenses, diaphragms, or color screens, which may be readily changed or adjusted by means of the screw cap. The inner threaded portion is soldered into a suitable opening in the door panel.

A number of lenses of varying degrees of density or color may be secured from "sun" or "dark" glasses to suit the individual requirements. The diaphragms or stops for regulating the amount of light that passes may be cut from thin vulcanized fiber (or cardboard) with different sized openings, as desired. The screw cap holds them tightly.

A small 110-volt lamp with candelabra base, of the outside frosted type, and a base, a length of lamp cord, and an attachment plug complete the device. Although the lamp gets rather warm, it was not found necessary to provide for ventilation, but this could be easily done if desired.

Finish the casing with aluminum paint on the inside and use what ever color you desire for the outside, and you will have as fine a microscope lamp as any professional could desire.—R. GERALD BULLARD.

SHELLAC FASTENS HOSE WASHER

WHEN the garden hose was moved for various uses in the yard, garage, and laundry, it often happened that the coupling washer would be lost. This caused an irritating delay while another washer was being obtained, but it was finally prevented by fastening the washer securely in place with orange shellac.—RALPH M. MCPHERSON.

Novel Jig-Saw Puzzle

MADE IN FORM OF CUBE

By George S. Greene

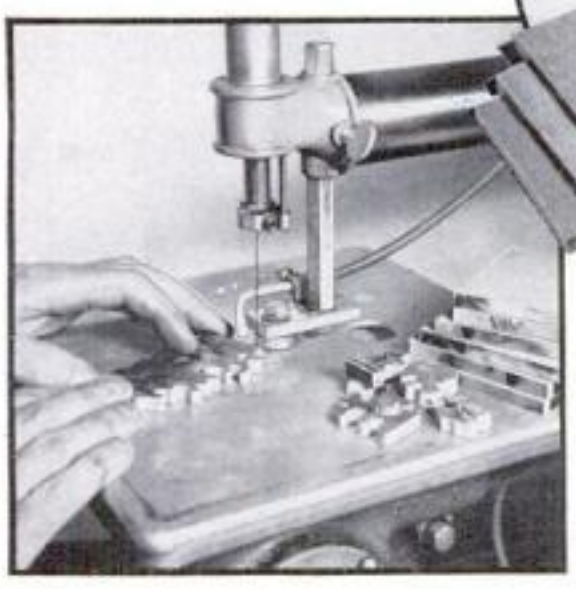
The assembled puzzle has a different picture on each side

THIS new and unusual type of jig-saw puzzle forms a cube when assembled and has a different picture on each of its six sides. When the parts are spread out and well shuffled on the table, they resemble those of an ordinary picture puzzle, except that some of the pieces have no indication of pictures on them at all to aid in the assembly.

A convenient size to make the puzzle is 3 in. in each dimension. Twelve 3-in. squares of some thoroughly dry, close-grained wood ¼ in. thick are placed in a clamp, and the six faces are smoothly sanded. Maple is an excellent wood for this purpose, if available.

Each side is then covered with a picture. Small sections cut from colorful magazine covers are suitable. The adhesive used must be a good one, such as white casein glue—the type ordinarily designated as No. 2. Mix the dry powder in cold water in the proportions of one part powder to from 1⅛ to 1½ parts water. Apply the glue, after it has been mixed until there are no lumps, with a stiff, short brush to insure a thin film of heavy glue that covers the entire surface perfectly. Let this strong film of casein glue set for at least five minutes until tacky before applying the prints, and then smooth the paper down carefully to insure against blisters.

The thin squares are clamped together and thoroughly smoothed; then the pictures are glued on. The squares are later separated with a razor blade, and each is sawed into interlocking pieces like any other good jig-saw puzzle



When the glue is dry, the squares should be separated neatly with a razor blade, and each cut into as many interlocking pieces as desired in the usual manner. In putting the puzzle together, assemble each square first; then bring the squares together so the pictures line up.

Unusual Butler's Table

has removable tray with folding sides

By HERMAN HJORTH

Author of *How to Make Veneered Panels*

AMONG the more expensive of the many varieties of small tables so much in vogue in the modern home, the so-called "butler's table" is one of the most unusual and serviceable. It may be made of any good cabinet wood.

The frame consists of four legs and four rails joined with mortise and tenon joints. In addition, if desired, a light plywood top may be fastened on top, as indicated in the illustration at the right. In that case four rubber headed nails are set in the bottom of the removable tray, which rests on the plywood top. In the original table, however, the top frame was left open and small blocks were glued to underside of tray to hold it in place when set on the frame.

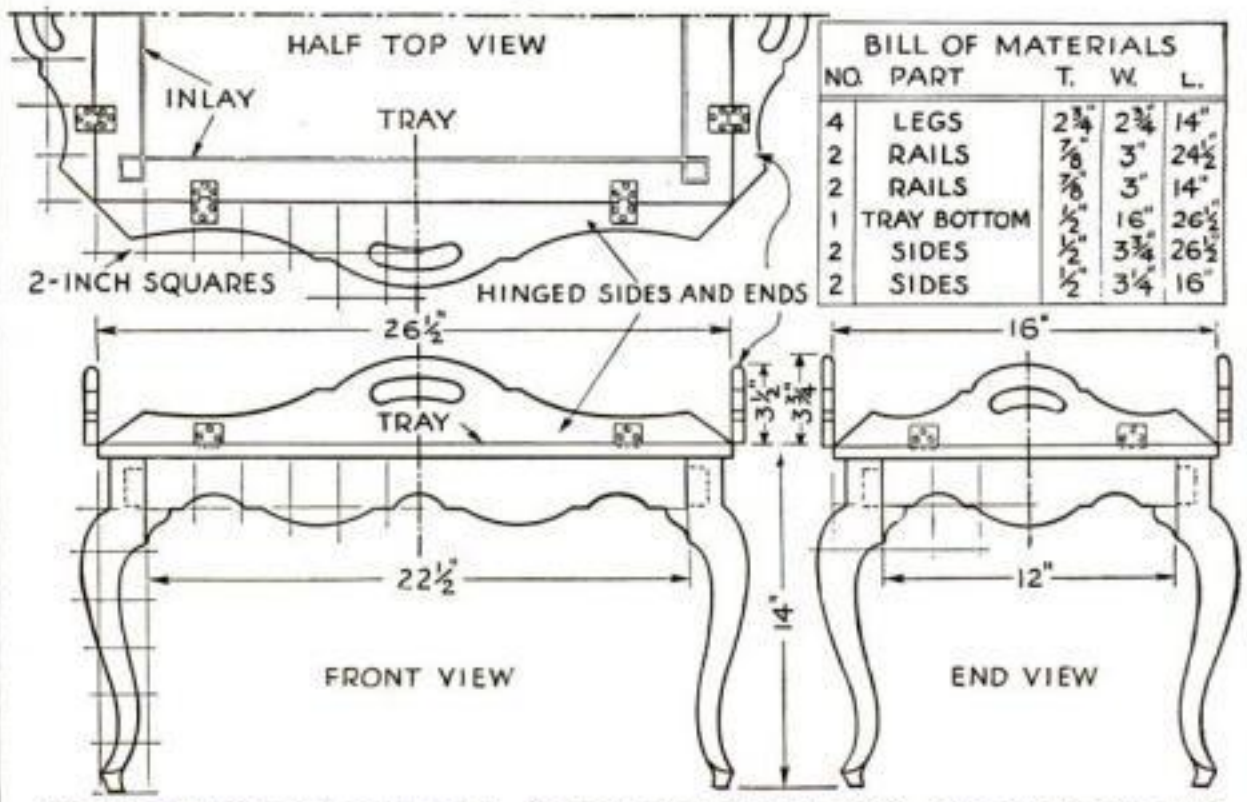
The legs of this particular table are of the cabriole type and were made as explained in previous articles (see especially P. S. M., Aug. '31, p. 106). The design may be modified by using either turned or square legs.

The tray bottom may be plywood or solid wood, either plain or inlaid, or it may be veneered. There are four hinged sidepieces. It is best to make the openings in these before sawing the outline. Bore a ¼-in. hole at both ends of the opening and then cut away the waste wood with a coping or jig saw.

The hinges used are brass desk butts. Pick

For carrying food from the kitchen, the tray has all sides turned up, and it is easily handed from one to another

The table is more decorative with tray sides up, but they can be turned flush with the bottom for greater convenience in serving the refreshments



BILL OF MATERIALS

NO.	PART	T.	W.	L.
4	LEGS	2¾"	2¾"	14"
2	RAILS	⅞"	3"	24½"
2	RAILS	⅞"	3"	14"
1	TRAY BOTTOM	½"	16"	26½"
2	SIDES	½"	3¾"	26½"
2	SIDES	½"	3¼"	16"

Working drawings and material list. The legs are made from 2¾ in. square stock, but small corner blocks are glued in place between the legs and the rails after the frame is glued up

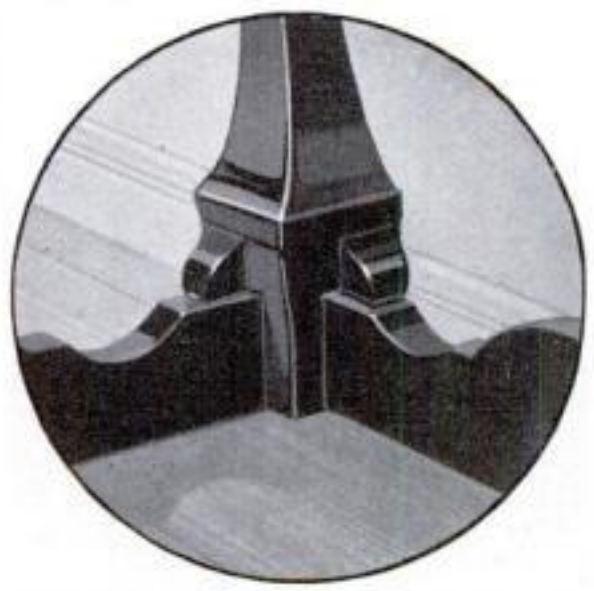
out ones that are of good quality and open stiffly so that the sides of the tray will stand up by themselves. The length of the joint is ¾ in., and the hinges measure 1 5/16 in. when open. The screw holes in the hinges are countersunk on the reverse side with an ordinary rose countersink. Since they are already countersunk on the right side, this will have the effect of enlarging the holes, therefore use thicker brass screws, such as ⅜-in. No. 5. Mark the position of the hinges carefully, using a sharp knife point, and chisel a recess equal in depth to the thickness of the leaves. Place the hinges with the knuckle down and cut a small groove for the latter so that the leaves can be set flush with the

The tray with its sides turned down. The brass hinges are set flush with the surface

surface. It is necessary to plane a small chamfer about ⅛ in. wide on the upper edges of the tray bottom and sides.

After the wood has been stained to the desired color, it may be finished with four or five coats of very thin shellac. A very good grade of shellac must be used, and it should be mixed with denatured alcohol until it is as thin as water. Each coat should be allowed from two to four hours for drying, after which it should be rubbed down with No. 3/0 steel wool or No. 4/0 waterproof sandpaper. The successive coats of shellac gradually fill up the fine pores in the wood and produce a beautiful soft finish. The final coat should be rubbed down with a felt pad, powdered pumice stone, and oil.

The hinges are usually left in the original bright brass finish, but they can be toned down, if desired, with a mixture of shellac and stain.



Detail of the frame, set upside down to show particularly the blocks between legs and rails

OUTBOARD SPEEDSTER WILL WIN RACES

(Continued from page 61)

is attached. The step filler piece is next fitted, coated with casein glue, and inserted between the ends of the keel at the step. Two 3/16-in. holes are drilled through the ends of the keel and filler piece, and 3/16-in. stove bolts inserted. The nuts are drawn tight when the frame is turned over. See the drawings on this page for details of the step filler piece.

The transom and step frame are squared and held by nailing pieces temporarily from the transom and step to the keel.

The after chines are clamped in place and the after frames squared. Fasten the chines to each frame with one 1¾-in. No. 8 screw. It should be noted that the forward ends

LIST OF MATERIALS FOR RACER

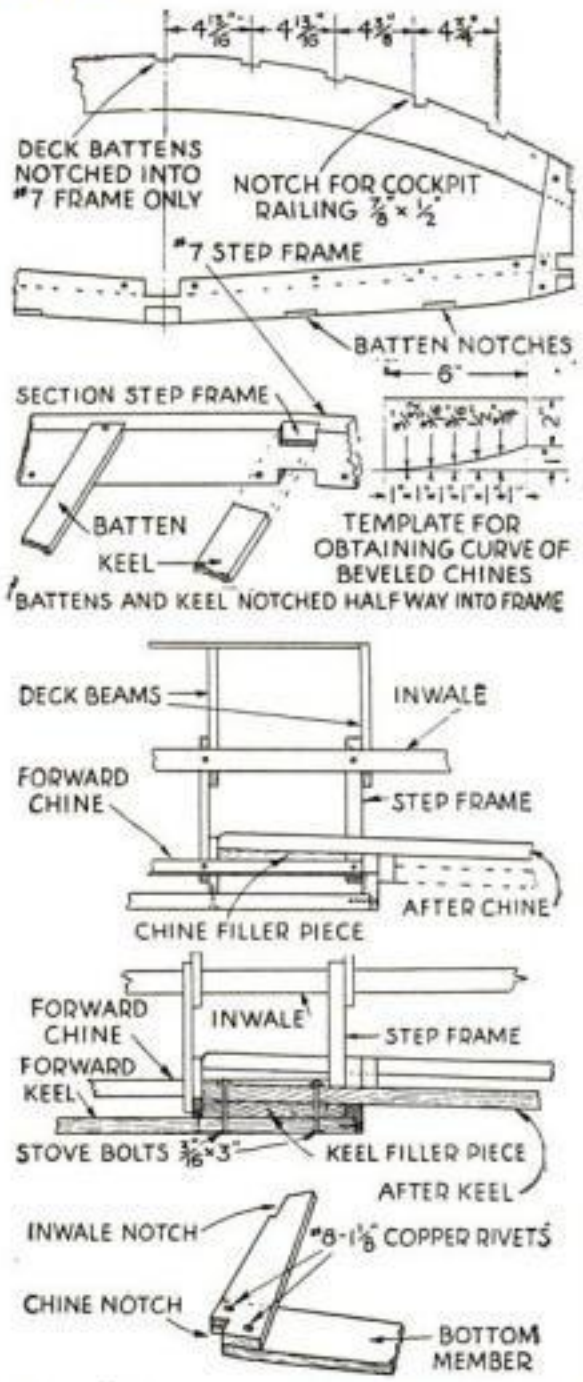
For	Quantity	Material*
Form	2" x 10" x 10'	YP
Planking	Sides— 2 pc. ¼" x 8" x 12'	
	Bottom— 2 pc. ¼" x 8" x 12' 2 pc. ¼" x 8" x 10' 2 pc. ¼" x 8" x 8'	M, POC, RC, WP, or Cy
Cockpit decking	1 pc. plywood ⅛" x 26" x 60" or	M or F
	Planking— 1 pc. ¼" x 10" x 10' 1 pc. ¼" x 8" x 6'	M, C, or P
Coaming	2 pc. ¼" x 5" x 5'	O, A, Map, or YP
Flooring	1 pc. plywood ¼" x 24" x 36"	F or M
Frames	1 pc. ½" x 12" x 12'	S, F, or M
Deck beams, drip board, steering wheel support, and motor board	2 pc. ½" x 12" x 10'	S, F, or YP
Transom and step assembly	1 pc. ⅞" x 12" x 8'	S, F, or M
Stem and step filler piece	1 pc. 2" x 6" x 10"	S, F, or YP
Keel	1 pc. ⅞" x 2" x 12'	S, F, or YP
Chines	2 pc. ⅞" x ⅞" x 12'	S, F, or YP
Sheer batten or inwale	2 pc. ¼" x 1¼" x 12'	S or F
Planking battens	2 pc. ¼" x 1¾" x 10' 2 pc. ¼" x 1¾" x 8'	S, F, or M
Deck battens	5 pc. ¼" x 1" x 6' 2 pc. ¼" x 1" x 4'	S, F, C, YP, P, or M
Cockpit railing	2 pc. ⅞" x 1¼" x 6½'	S, F, or YP
Molding	2 pc. ⅝" half-round	S, M, O, or A

Waste will make various other pieces not mentioned.

*Key to Materials: A, ash; C, cedar; Cy, cypress; F, fir; M, mahogany; Map, maple; O, oak; POC, Port Orford cedar; RC, red cedar; S, spruce; WP, white pine; YP yellow pine.

HARDWARE AND FITTINGS

7 gross 1" No. 6 F. H. brass screws
30 1½" No. 8 F. H. brass or gal. screws
70 1¾" No. 8 F. H. brass or gal. screws
9 3½" No. 9 F. H. brass or gal. screws
1 lb. No. 8 1⅛" copper rivets and burrs
½ lb. ¾" copper cut clout nails
2 oz. ⅜" copper or gal. tacks
1 qt. aviation glue (liquid)
½ gal. nitrate wing dope
1 gal. spar varnish
½ lb. casein glue (waterproof)
2 yds. 48" width muslin
2 3" x 3/16" F. H. stove bolts
1 outboard lifting handle
1 outboard steering wheel
20 ft. ¼" tiller cable
1 outboard fin about 5" x 10" (aluminum)
2 ¼" tiller rope pulleys
Strips of cloth for use between battens and planking



How the frames are notched, details of the step, and other views to help the builder

of the after chines butt against frame No. 6. Both forward chines are fastened simultaneously to prevent pulling the frame out of shape. The forward ends of the chines are sawn to shape and screwed to each side of the keel with one 1½-in. No. 8 screw, as shown in diagram.

The chine filler piece between frames Nos. 6 and 7 is now fitted and fastened with two 1¾-in. No. 8 screws. Coat the filler piece with casein glue before fastening.

The stem is next clamped in place and fastened to the keel with two 1¾-in. No. 8 screws.

After straightening any frame side members that may be out of line, clamp the sheer batten or inwale in place and attach it to each frame side member with one 1-in. No. 6 screw. The inwales at the stem are beveled out to nothing and fastened to the chine with one 1-in. No. 8 screw.

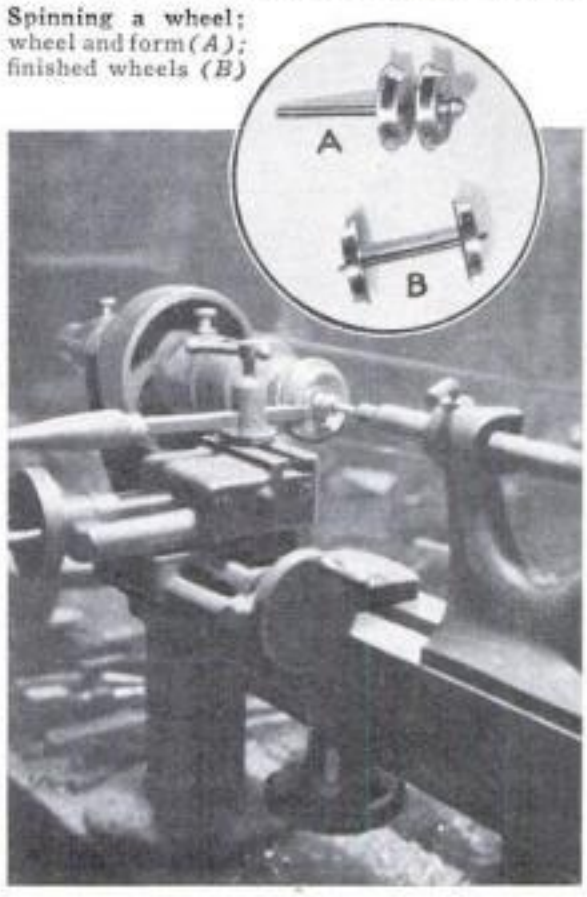
The entire frame is now trimmed and faired. A light batten laid over the joints will show any unevenness.

Before planking the sides, level the step and transom frames. If the floor is level, this can be accomplished by measuring from the floor up to the frames. By clamping wood strips to the step and transom frames, with the other ends of the strips resting upon the floor, the frames may be brought in line with one another. This is important because the speed and level riding qualities of the hull depend upon the proper alignment of the two planes. *(To Be Continued)*

MODEL RAILWAY WHEELS MADE BY SPINNING

TOBACCO tins or other sheet metal of similar thickness and softness can be used for making spun metal wheels for model railway rolling stock. To shape wheels by this method, a form is necessary. This can be one of the iron truck wheels on any available car. The wheel is removed, placed on a shaft of a diameter to suit the axle hole, and held with a nut threaded on. A piece of tobacco tin is cut ¼ in. larger than

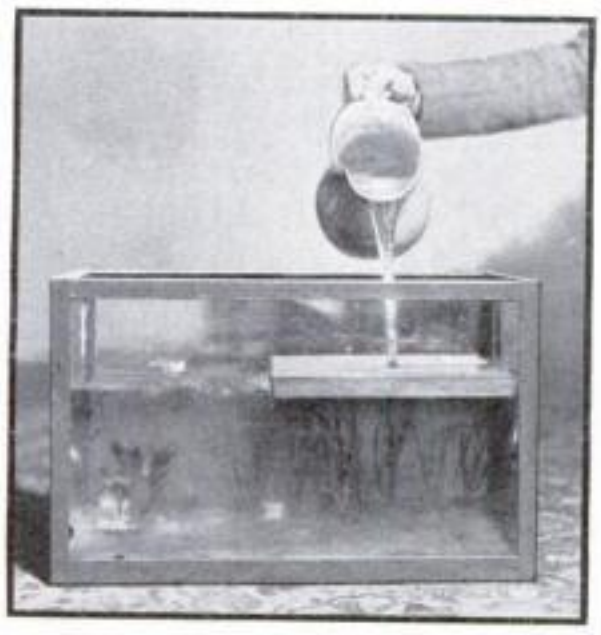
Spinning a wheel; wheel and form (*A*); finished wheels (*B*)



the wheel form and clamped tightly between the form and nut on the shaft. The form and blank are set up in the lathe and run at top speed. A well-greased brass or hardwood tool with a blunt end is applied with gradual pressure to the tobacco-tin disk until the proper shape has been obtained. The wheel ready for removal is shown at *A*.

Lead is poured into the wheels to eliminate the tin ring which they would otherwise have when rolling and also to give better traction. A pair of these wheels are shown in insert *B*.—J. G. MARINAC.

FILLING AN AQUARIUM



WATER can be added to an aquarium without disturbing the plants and sand if a board is floated on the surface as shown above. It should be about ¾ in. thick, and of suitable size.—W. M. M.

Our CONSTRUCTION KITS
Will Save Your Time

KIT NO. 3

KIT D

KIT NO. 4

A CAREFULLY selected, timesaving kit of raw materials for building a picturesque model of the famous Elizabethan galleon *Revenge* is the latest addition to the construction kits offered by the Popular Science Homecraft Guild.

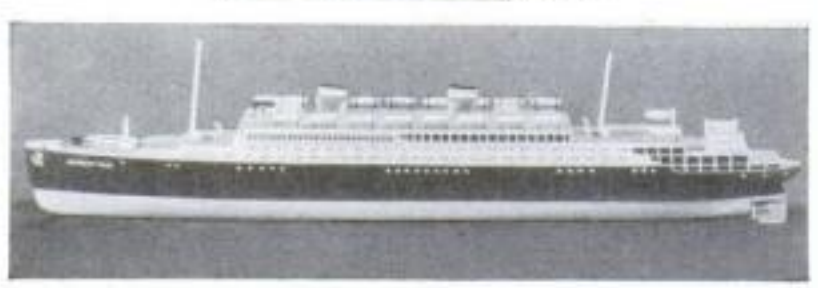
The new kit, marked *G* in the list below, contains a plywood centerboard sawed to shape and two plain white pine side blocks for making the hull, all the necessary thin plywood, chair caning spline, hardwood for small fittings, celluloid, dowels, wire, rigging cord, sailcloth, silk, beads, brads, pins, escutcheon pins—in fact everything but glue and paints. If, in addition, you wish the two main side blocks of the hull shaped and finished, order the kit marked *GG*.

The other kits available are also shown in the following list. Each is accompanied by instructions or blueprints.

NO. 2

KIT G

KIT A



KIT F—Materials for 12-in. model of *Manhattan*

A. Whaling ship model *Wanderer*. All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154. The hull is 20½ in. long....$6.90

AA. Same with hull lifts sawed.... 7.40

D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet.... 6.45

DD. Same with hull blocks shaped.. 6.95

E. Battleship model, U. S. S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

EE. Same with hull lifts sawed.... 7.45

F. Liner *Manhattan*. All raw materials (except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204.. 1.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209.. 6.75

GG. Same with hull blocks shaped.. 7.25

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble..... 5.90

No. 3. Tilt-top coffee table in selected maple with top 19 by 28 in., and 21 in. high. Ready to assemble..... 7.15

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble..... 5.30

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me Kit..... for which I inclose $..... (or send C. O. D. ☐)

Name .....

Address .....

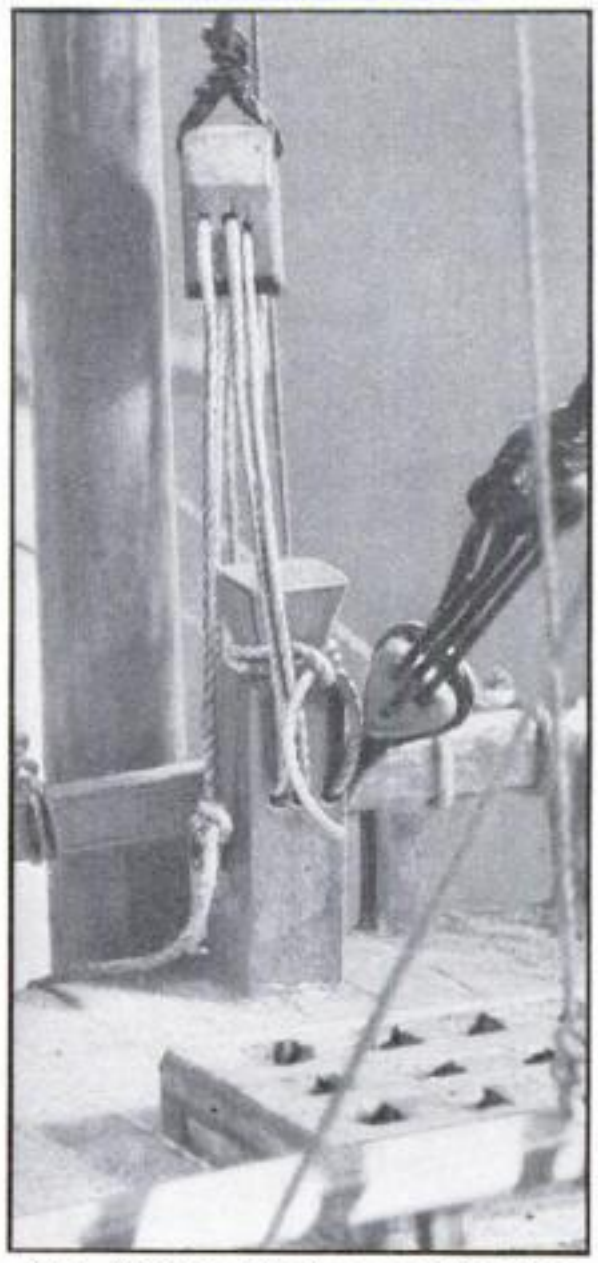
City ..... State .....

(Please print name very clearly.)

Note: Prices of all kits except *F* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount to 28 cents. Kit *F* cannot be sent C.O.D. This offer is made only to readers in the United States.

FINISHING THE HULL OF THE *REVENGE*

(Continued from page 67)



The knight just aft the foremast. It has three sheave holes and an eyebolt at one side

Elizabethan ships. It is true they were overmanned. Even the *Revenge* had a crew of 150 mariners, 24 gunners, and 76 soldiers. Furthermore, the crew got but ten shillings a month, was forced to eat the coarsest of food, and had to endure the constant stench of bilge water in the gravel ballast. All that is forgotten, however, and nowadays one thinks of the *Revenge* only as a gay ship with decorated sails and with flags, banners, and streamers fluttering while she quarters the chops of the English Channel and awaits the mighty Spanish Armada. When the enemy fleet arrived, it did not take long for Drake, her fire-eating commander, to catch the great *Nuestra Senora del Rosario* and compel her to strike her colors.

Our intention is to make an ornate model of the *Revenge* without straining too hard for strict accuracy and completeness—in other words, without doing any unnecessary work. How to construct the hull, bulkheads, decks, and bulwarks was told last month (P.S.M., Apr. '33, p. 65). Those who missed that issue, should look it up.

Below the bulwarks there is a heavy wale. This almost touches the water line at its lowest point, as will be seen in the illustration at the beginning of the article. It was shown clearly in the photographs published last month and also appears on the full size blueprint drawings of the sail plan. This wale will require steaming unless you use chair spline, which is sold for holding machine woven caning in the grooves of chair seats. The wale is carried across the stern as shown in the left-hand photograph on page 67.

The next wale up is merely a painted line on the lower edge *(Continued on page 91)*

SLIPKNOTS FORM WAMPUM BELT

(Continued from page 63)

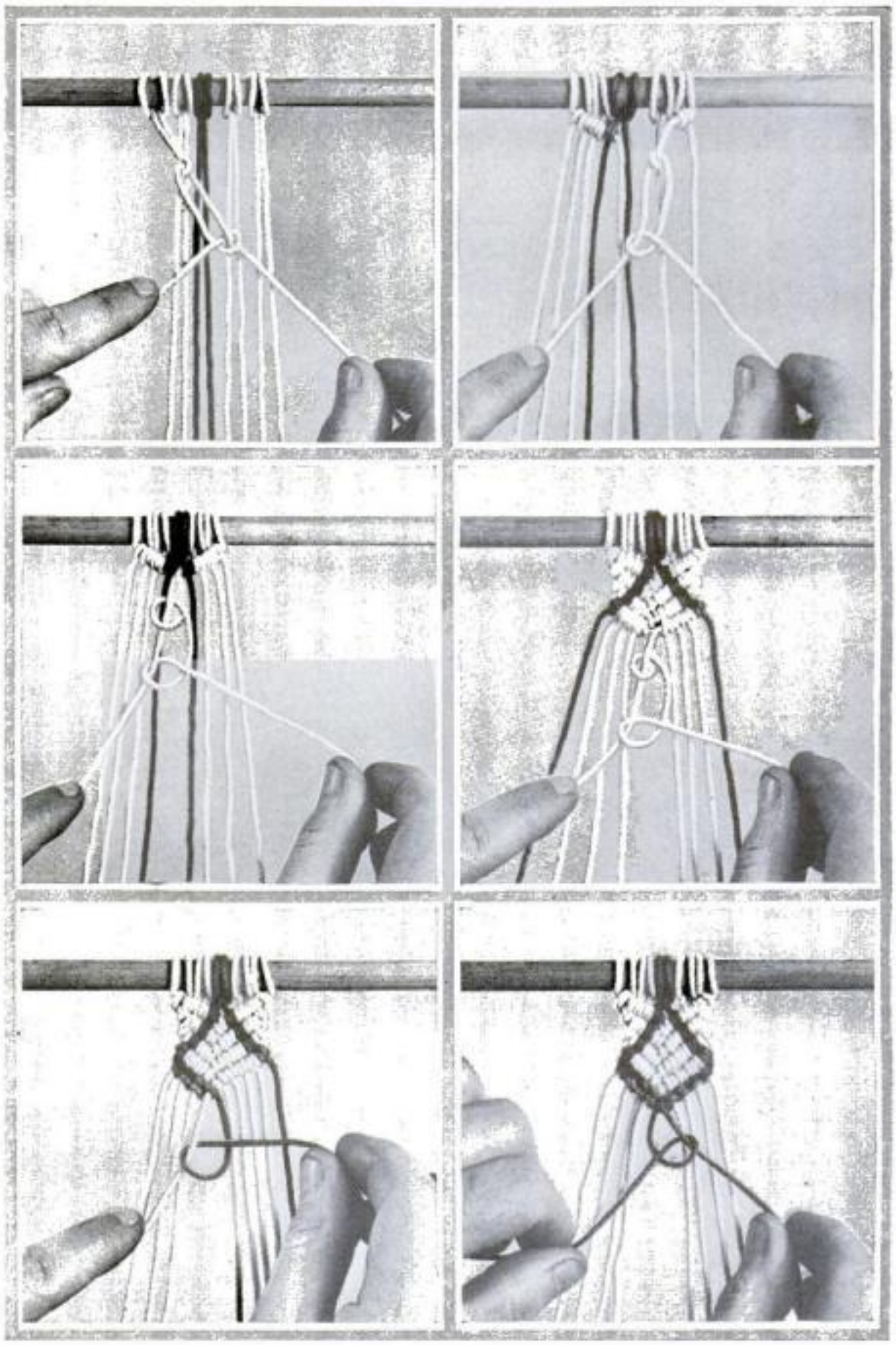


Fig. 7. How the tying is done. First, double-knot the second cord over the first. Second, repeat at the right-hand side until the fillers come to the center. Third, knot the two filler cords together. Fourth, continue until the blue cords are at the outside, knotting the fillers together at each row. Fifth, return the blue cords to the center by knotting them over each of the other cords. Sixth, knot blue cords together and continue the process

forms a blue diamond against the gray cord.

The process is repeated continuously, and the belt is ended by keeping the blue in the center for a distance of 5 in. as shown in Fig. 3. To do this, reverse all knots made with blue cord. Cut the cords ½ in. from the belt, fold over, and sew to the back.

By using a clamp and a ruler as shown in Fig. 6, the work may be held securely and can be advanced as necessary. The push pins hold the cords to one side and out of the way. To make it easy to handle the long cords, tie them into hanks several feet from the knotting as in Fig. 5.

The design shown at the right of Fig. 4 is made by working the first part of the diamond design continuously without returning the blue cords to the center. That at the left of Fig. 4 is started from the right by taking the second cord over the first; then the third, second, and first over the fourth; the fifth to first over the sixth; the seventh to first over the eighth. Continue by using the left-hand cord as a filler for the others for each row. All knots are left-handed.

In the design in the center of Fig. 4, a single white cord acts as a continuous filler in the general shape of a letter "Z." Any design can be worked in by knotting the white cord over two blue ones wherever desired.

This is the fourth of a series of articles on knot work (see P.S.M., Nov. '32, p. 77, Mar. '33, p. 68, and April '33, p. 75).

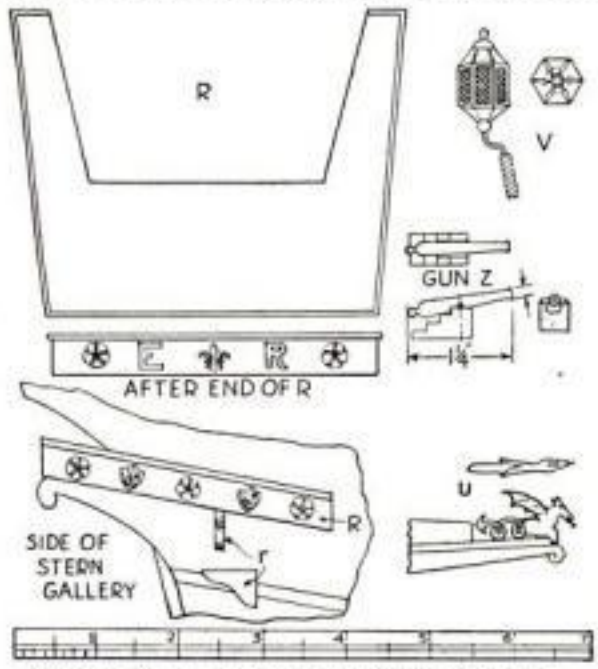
FINISHING THE HULL OF THE *REVENGE*

(Continued from page 89)

of the bulwarks. The other wales are strips of 3/32 in. square wood, glued on. Similar strips are glued at the top edges of the handrails all the way around. The wales are painted a dull red everywhere. The handrails on the outside and top are white with slanting red stripes. Inside they are stained brown like the bulwarks.

The stern gallery is a flat board cut to the shape shown at *R* on this page with ½ in. high sides around it and the usual 3/32-in. edging. This platform rests on the extension of centerpiece *A* and has at least one bracket underneath at each side, as shown in detail *r*. The outside of the gallery is colored black with painted shields depicting the Tudor arms and Tudor roses. Astern is the royal cipher E. R. in gold. These can be more easily painted on cardboard and then glued in position.

On each side of the main-deck gun ports, slips of wood are glued, and between them



Details of the stern gallery and brackets, stern lantern, guns, and dragon figurehead

shields and roses are painted as on the gallery. A port lid is glued above each gun-deck port. These lids can be the pieces cut out of the bulwark. They are, in addition, fastened with eyebolts made from pins. The (upper) quarter-deck gun ports have doors equal to half the size of the openings. These are glued on each side. All ports are red and have black hinges painted on.

Overlapping ¼ in. and nailed to the front edges of the bulwarks and extending along the beak deck *D* are the sidepieces *P*, a photograph of which appears on page 67. An open door is cut in these pieces. Three strips are glued on; the top one, which follows the curve, is like the handrails, and the two lower ones are straight. Between the latter, pieces *P* are painted black with a gold acanthus pattern.

Into the bows of the hull, just under *P*, the hawse pipes are bored to take the anchor cables. For these I glued on ⅛-in. pieces of wood ⅝ by ⅜ in. and bored two 3/16-in. holes in each, pointing aft and up.

On the end of the beak deck is the figurehead *U*. This can properly be a dragon, griffin, or lion. We have chosen the former, as can be seen in one of the drawings above. It is fret-sawed to shape and then lightly carved with knife and files. Finally it is glued and nailed down, but it is better to leave it off until the rigging is completed.

This is also true of the stern lantern *V*. It is made to the size and shape shown. It is a six-sided block, with button molds above and below, and through all is passed a large headed pin. Panels *(Continued on page 93)*

HOME WORKSHOP BLUEPRINTS

New projects are marked with an asterisk (*)

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions originally published in the magazine. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given. Reprints alone are sold for 25 cents each.

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FINISHING THE HULL OF THE *REVENGE*

(Continued from page 91)

are cut in the flat sides, and in these are set silver paper and cellophane. These "glasses" are lined in black to represent panes. The lower end of the pin is set in a hole in the stern board.

The hatches *W*, shown in the drawings last month, are made as for the beak deck, but the gratings are set on a thin piece of wood painted black on top and sides.

The overlays *e, g, h, j,* also shown last month, can be applied at any time after the bulwarks are up. On my model the overlays are 1/16-in. plywood, but cardboard would do. They are used merely because it is easier to get a neat finish this way than by carving and painting the bulkheads themselves, of which they are supposed to be part. Doors and windows can be carved, with panels sunk in. The overlays are glued to the bulkheads.

AT ABOUT this stage of the construction the mast holes should be bored through the decks. Start with small holes and enlarge them to come fair with the slots cut in the centerboard. To bore for the bowsprit, which passes to starboard (right) of the foremast, ship a temporary foremast and then bore a 5/16-in. hole close to it and close to the deck on the starboard side at the correct angle and so that the forward end of the sprit will point slightly over toward the middle line.

The four knightheads, illustrated on page 89, can now be set in position. They were also shown in detail *X* last month. Each has sheave holes for three cords in a fore-and-aft direction, and an eyebolt on one side. The catheads *XX* are quite similar.

There are two ladders, one at *Y* as shown on the deck plan last month, the other going to the poop deck on the port side. They are most easily made of strips of wood, which should be a full ⅛ in. by a bare 1/16 in. The sides are cut to the right length, with the ends at a slant; five or six notches are filed at the same slant inside each side; the steps are cut, all of exactly the same length, with sharp ends to fit in the notches; and the whole is glued together and held in position with long pins on a board.

THE eight guns that show are made as in detail *Z* of wood, brass, or lead, with pins through them for trunnions. The gun carriages are cut with steps and notched down the middle to take the guns, which are held with a touch of glue and bent-pin staples. The guns can be made a shade less high and have wheels, if you wish.

The lower deck guns are the same size or a trifle larger, and need have only their outer ends shaped. The carriages may well be a bit larger. The guns are fastened to them with trunnions or merely held down by nailing through. The carriages are well glued underneath and passed through the gun ports and held down until the glue takes hold. See that they point level or slightly upwards and at a right angle to the hull.

The rigging will be taken up in the third article, which will be published next month.

MICROSCOPE SLIDES PREPARED WITH GUM PATCHES

IN MOUNTING specimens for examination with a low-power microscope lens, I have used very satisfactorily cells made with gummed cloth stickers sold for reënforcing the holes in loose-leaf notebook sheets. Place the glue side down on the slide, set the specimen in the center, cover the rim of the cloth patch with Canada balsam, and add the round cover glass. This method is much easier than building up a cell with shellac.—T. G. HETRICK.

PRESERVING SPECIMENS FOR YOUR MICROSCOPE

(Continued from page 39)

happen that we want to peer into the inside of specimens and learn the structure of their internal parts. This curiosity is especially keen in regard to the stems of plants and flowers. Cross sections will reveal their wonderful and intricate layers of cells and delicate connecting tissues.

It is obvious that very thin slices of the stems must be cut off in the preparation of such specimens. Indeed, they must be so thin that light will pass through them. To cut slices as thin as this is no small task although from stems that are not easily crushed, slices may be cut with an ordinary safety razor blade. The cutting is done under a reading or magnifying glass and the slices are made as thin as is humanly possible.

IN A more professional method of cutting the slices, an instrument known as a microtome is used. In our next article we shall not only learn to use such an instrument but we shall also be told how one may be made at home with a few simple tools and materials.

The beginner should not become too ambitious in his efforts to mount specimens. If, for instance, he attempts the mounting of any live specimen containing viscera, he is sure to make a botch of it. Our next article will deal with this difficult subject and will tell you exactly how such specimens are mounted so you can make them for yourself.

In cataloging and filing our microscopic album, we shall need a few more simple accessories. Cataloging really should be done as it gives a nice professional touch and makes your collection ready for instant use.

A sticker, bearing the name of the specimen and the filing date, is pasted on each completed slide. Such stickers may be bought at any stationery store. On the end of the box in which the slides are filed is pasted a slip of paper on which is written the names of the slides it contains. Each box is numbered and reserved for a distinct subject.

While such filing boxes may be had at a trifling cost, it is fun to make them. If a dozen or more are made at a time, they will cost you very little in labor or cash.

Soft pine is used for the body of the boxes. The little comb-shaped pieces between which the slides are slipped may be cut by mounting together two circular saws of the same diameter and arranging the saw table so that a cut halfway through the stock will be made. In this way, these pieces may be run through with lightning speed. They are fastened to the sides of the box with carpenter's glue.

IF A dozen boxes are made at once twenty-four ends and slide pieces are put through at a time. As plywood is a little thick for the tops and bottoms of these boxes, a better material to use is cigar box wood.

After each box is finished, by nailing it together with small brads, a long strip of paper, numbered from one to twenty-five, is glued to the bottom in such a way that slide number twenty will be directly above the number twenty on the paper. This makes it easy to find any desired slide.

FORESTS IN U. S. SHOW A BIG INCREASE

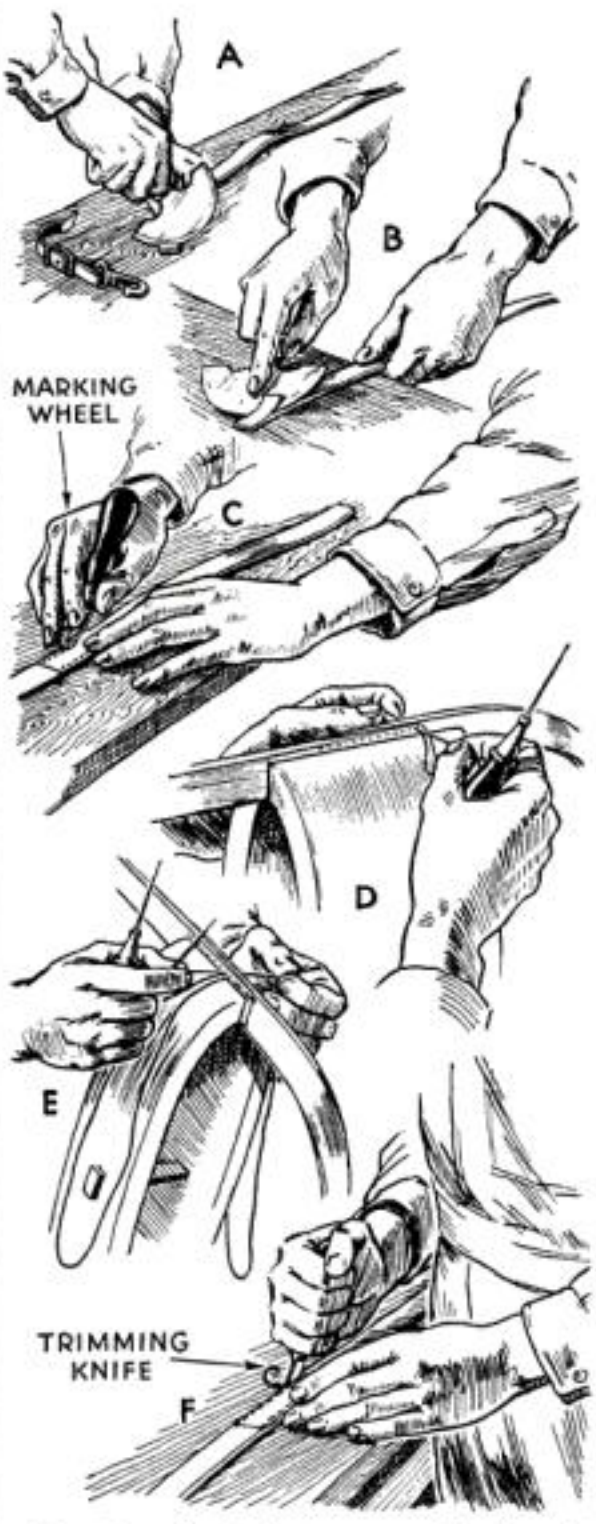
AMERICAN forests have staged a 33,000,000-acre comeback since 1920, according to the latest reports of the U. S. Forest Service. This gain in wooded land represents more than a six percent increase in twelve years. The total area now occupied by commercial-forest tracts is put at nearly five hundred million acres. Three-eighths of this bears trees large enough for saw wood, one-fourth bears timber of cord-wood size. Scrub and brush cover the rest.

Making a Stitched Harness Splice

By L. M. ROEHL
New York State College of Agriculture

IN REPAIRING harness on a farm, it is often necessary to make a stitched splice. The tools needed are a knife (preferably round as illustrated), a finishing wheel, a marking wheel, a sewing awl, a clamp, waxed and needled harness thread, and a clamp. How to prepare the thread was told in a previous article (P. S. M., April '33, p. 99).

1. Cut ends of straps square as shown at *A*.



How the ends of the straps are skived, and steps in stitching and trimming the splice

2. Skive off or taper the ends on the flesh or rough side of each piece for about 1½ in. as at *B*.

3. Lap the straps about 2 in. and mark off the stitches the full length of the splice as at *C*.

4. Place the splice in the clamp with the marked side and the end nearest you facing right and the marks close to the jaws of the clamp as at *D*. Make the first hole in the single strap farthest away from you (beyond the splice). Place the thread in the hole and draw the ends even. The awl is kept in the right hand. Make the second hole and place the left needle in it, and draw it about 1 ft. through with the thumb and index finger of the right hand. With the awl and both needles in the right hand, pass the right-hand needle through the hole, draw it through with the left hand, and pull the stitch up tight as at *E*. Continue this until the last stitch has been made through the two straps.

5. Make one hole beyond the splice and pass the right needle through. Remove the work from the clamp, cross the threads, replace the work in the clamp end for end with the other edge up, and continue the stitching.

6. Finish the stitching by placing the left needle and thread in the last hole, which is beyond the splice; then, when the right needle is in the hole, the left thread is wound twice around the right needle, and the threads are drawn tight. This ties and locks the thread.

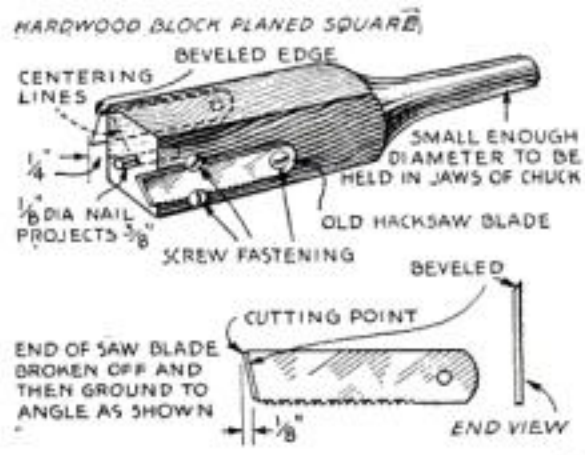
7. The right thread is then passed through another small hole about ⅛ in. below the next to the last stitch, and the threads are cut off close to the strap.

8. The stitching is then smoothed down with the finishing wheel, and the edges are trimmed smooth with an edging tool or knife as shown at *F*.

IMPROVISED TOOL CUTS HOLES IN THIN METAL

THIS improvised tool will cut circular holes through any comparatively soft metal up to ⅛ in. thick without marring the surface, even if painted or lacquered. It will also cut through pieces of thin gage without bending them.

If a 1-in. hole is required, for example, plane a stick of hardwood 1 in. square, cut it off about 4 in. long, and round one end so that it can be gripped in the jaws of a brace.



The assembled tool and a drawing of one of the cutting blades to show how it is ground

Mark the square end of the piece with diagonal cross lines, and where they meet bore a ⅛-in. hole 1 in. deep. Drive a headless nail into this hole, allowing it to project about ⅜ in. Now take an old hack saw blade and break off a piece from each end, including the eye, approximately 1½ in. long. Grind each as shown and fasten them with short round-head screws to two opposite sides of the block. Smaller screws driven beside each blade will prevent side motion.

Drill a ⅛-in. guide hole in the metal, slip the nail into this, and turn the brace until the cut has gone half through; then cut from the other side.—J. ANDERSON.

GOOSENECK LAMP HEATS TROPICAL AQUARIUM

AN ORDINARY gooseneck lamp placed close to the surface of the water in a tropical fish aquarium will supply the extra heat needed to maintain the proper temperature in the spring and fall when the furnace is out of service. By moving the bulb to or from the aquarium, the heat may be regulated so that just the right amount is radiated at all times.—KENNETH MCWILLIAMS.

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FROM CHEMISTRY COURSE TO OWN FACTORY

READERS of this column should find the following story of unusual interest, because it deals with success on a small, but perfect scale. In times like these nothing can be more heartening than to learn that young men can and do find ways of making money by methods somewhat off the beaten track.

James Cogswell, of Pasadena, attends a local military academy and, because of circumstances, finds it necessary to pay for his own way. He is operating a small, homemade and home-financed chemical plant. The Government will never get rich on the income tax returns from this business, but James Cogswell is making enough to pay for his tuition, buy his clothes, books, board and food.

The product he makes in this plant is lampblack, and the process involved came directly as a result of his chemistry studies and experiments. Here, in itself, is an example of the practical application of knowledge and study to the business of making a living. It was the application of his work in chemistry, coupled with actual painstaking laboratory experiments, that led to the installation of equipment that automatically converts ordinary, crude fuel oil into a high grade of lampblack generally specified and used by contractors.

This is the way it is done. The crude oil is burned in a steel drum with valve inlets that control the amount of air fed to the flames. From this incomplete combustion process is obtained a thick, heavy black smoke, laden with carbon particles (lampblack). By means of a small, homemade suction fan the heavy smoke is drawn off and led into a series of settling chambers, so built that the lampblack will collect along the bottom of the chamber while the gases pass through and are allowed to escape.

THIS lampblack is then packaged in one and five pound paper sacks. Cogswell has found a ready market for it among cement contractors, who use it to soften the glare of the otherwise pure white finish of cement used in road and sidewalk construction. Another popular use of lampblack is in coloring mortar in brick work.

The equipment used by Cogswell, with the exception of a small motor, is entirely home made. And while it is not a model of efficiency, it does its job well, converting a raw, crude oil, worth 65¢ into about $3.50 worth of *(Continued on page 97)*

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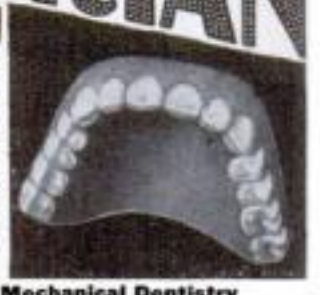

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Secrets of Success

FROM CHEMISTRY COURSE TO OWN FACTORY

(Continued from page 96)

saleable lampblack.

Cogswell takes advantage of the fact that he has no classes to attend on Saturday morning and delivers his product to his customers on that day. Distribution problems are rather simple, as two hardware stores and a building material supply company are taking up his entire output at present.

This small business of Cogswell's not only supplies him with a living, while still attending school, but also it will serve to give him a foothold on the business ladder when his school days are over and he must find some permanent full-time career. For he is certain that he can expand its present limits by devoting more time to it than he can now.—E. J. V., San Marino, Calif.

• • •

BECAME A SUCCESSFUL RADIO MARINE OPERATOR

FOR a great number of years after leaving school, my "career" was conspicuous in its lack of distinction, to say nothing of success. Mostly, I worked as a day laborer in all kinds of factories. I took any job that was to be had, as I was always up against the need of getting work immediately after leaving the last place.

My education was very limited, as I had not even finished grammar school. It was with great envy that I looked through the school advertising in various magazines—especially those advertising professional trades. To me it seemed necessary to have at least a high school education to enter one of these trade schools. Incidentally, even today a great number of fellows read these advertisements and turn away with this same, self-erected barrier in their minds.

After knocking around for a longer time than was good for me, and working at odd jobs here and there, I decided to take up a radio course in one of the schools whose advertisements used to fascinate me every time I opened a magazine. Fortunately, the school happened to be located in the city where I lived, and so I kept working during the day and attended classes at at night. After completing the course, I took my examination before the Local Radio Inspector and passed, receiving my license. Then things began to happen.

A short while after putting in my application for a posi- *(Continued on page 98)*

Secrets of Success

BECAME A SUCCESSFUL RADIO MARINE OPERATOR

(Continued from page 97)

tion, I was engaged and sent out as a Radio Operator on a passenger vessel sailing for the West Indies. Since that first job, which seemed like a little glimpse of heaven to me, I have sailed all over the world, touching ports I never dreamed existed. To say there is no comparison between this work and the work I did before taking up the school course is to make an under-statement!

I now have a profession that I can be and am proud of, and my work is steady, year in and year out. Not only is the pay good, but all my travelling and living expenses on duty are paid for. There's no such thing as a dull moment in this work, and I have that feeling of satisfaction about my job that makes it the biggest success a man can want.

To the man with no special training, and with a hankering for something better in life, I'd say that this is the time to take another look at that advertisement he has seen from time to time. I suggest writing for particulars and shaping a course for improving his future career. When these dull times are over, the demand for well-trained men in every line will be greater than ever. Take advantage of the lull now and be prepared for the boom that will come later. As for radio, to me its opportunities seemed limitless. As it has been up till now, with the trained men getting the best breaks, it will continue to be in the new fields that will be opened in the future.—H. R. Wallin, Brooklyn, N. Y.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

NO JOB TOO TOUGH FOR MINUTE-MEN COPS

(Continued from page 32)

wreckage, lay the night watchman, a heavy boiler pressing upon his crushed leg. But his groans proved he lived. Toward him, through the mass of wreckage, three policemen tunneled with tools from their green truck. At their heels crept Sergeant Michaels, with emergency kit, ready to amputate the victim's leg if need be to get him out.

Ambulance surgeons would not go into the tunnel for firemen warned that it would cave in. Almost it did, but not quite. The men in blue worked frantically, and at last, in triumph, they brought out the watchman—his leg neatly bandaged.

From tragic to amusing rescues is a transition the squads make every day. They play Providence to drunken men, boys and animals. One of the first, they salvaged from atop a wooden pile where he was marooned in the East River, forty feet from shore. Supposedly, he had crawled there from a passing boat; he couldn't remember.

THE noisiest of all the squads' many animal rescues, was when they lassoed a brown bear. He had strayed from a pet-shop into a tenement house. The bear roared, and the occupants screamed. Another time, Squad Fourteen threw a rope around a $10,000 prize bull that had jumped off a cattle-boat, landed at Coney Island, and chased the bathers. When lassoed, he was completing an eighteen-mile swim in the Upper Bay. A caf's meow has summoned many a policeman to risk life in an effort to retrieve a pet from a situation where, alive or dead, it threatened to be a public nuisance. Policemen have been lowered by ropes attached to lifebelts, from the roofs of tall buildings, to save cats from copings; they have used their knowledge of high-tension wires in climbing telegraph poles for the same purpose.

But such ordinary trifles cause only a fraction of the calls on which the green trucks roll. They have played a part in coping with all the great emergencies of recent months in New York. Last summer, an ammonia pipe-line in a refrigerating plant burst in the crowded lower East Side. Over eight blocks of tenements spread a miasma of choking fumes. Hundreds were gased; they lay in narrow hallways or staircases, on pavements or sidewalks where they had fallen. It was the emergency crews who revived them, and calmed the panic-stricken crowds.

Ten trucks rushed to Coney Island to handle a crisis caused by the $2,000,000 fire of last July. Here were 200,000 people, many with nothing but bathing suits, penniless, refugees in fog and smoke, milling about, some being overcome, some looting. Calming those people and getting them started home was the work of the green truck crews.

ONE of the most formidable offensive tasks the emergency squads have had, was the recent revolt of 1,600 prisoners on Welfare Island in the East River. One was killed, before the first police got there. An emergency truck reached the scene in three minutes, a battleship on wheels, with its full armament or rifles, shotguns, machine-guns, tear-gas and smoke grenades, and even bullet-proof vests and steel helmets for the crew. They waded into the milling criminals and soon had them under control.

Thus night and day, the green trucks roll in answer to the calls from the restless life of the great city. When they go out, they are prepared for any emergency. It may be a riot in Union Square, a helpless child clinging to a window ledge, an explosion in Wall Street, a mad dog scare in the tenement district, the body of a suicide on the roof of an annex. Whatever it is, they never hesitate.

NEW ARMY DRILL TURNS ROOKIE INTO SOLDIER

(Continued from page 15)

Under the new Regulations, this column of threes is the standard infantry column formation, replacing the time-honored column of fours.

"Forward, march!" The column stepped out briskly. "Column right, march!" The right-flank man of the leading rank faced to the right in marching, and took up a half step. The other men in his rank, without changing their intervals, circled to the right until they were abreast of the pivot man. Then they all stepped out in the new direction. The other ranks turned on the same ground, in the same manner.

"Form line to the right, sergeant," ordered the captain.

"Column right, march!" marked the sergeant. The column changed direction. "Section, halt! Left face!" And the section was back in its original triple-ranked formation.

TWO rifle sections form a rifle platoon, commanded by a lieutenant, with a platoon sergeant as second in command. The sections are formed in their normal three-rank formation, with a three-pace interval between the sections.

To increase the platoon column to a front of six men, the command "Platoon mass right!" was given. The leading section stood fast. The rear section executed "column half right," followed by "column half left," and halted when its front rank was on line with the front rank of the leading section. This formation is used mostly for passing in review, and for other ceremonies.

A rifle company at war strength is composed of three platoons and a company headquarters. Under the new Regulations the company is not considered a close-order drill unit. For it only such formations are prescribed as are necessary for ceremonies and marches. Most impressive of these formations is the company mass, which, with the company at full strength, gives it a front of eighteen men and a depth of eight ranks.

Prepared by a board of officers under the direction of General Fuqua, Chief of Infantry, the new Infantry Drill Regulations still are tentative, and are being given a thorough test by various units of the army. Undoubtedly, when reports on them come in, some changes will be made. But it is fairly certain that they will be adopted as the training bible of the modern doughboy.

IF THE United States gets in another war, it is probable that we will again face the problem of raising and training a large army in a short time. Every one of the many officers I talked with about the new Regulations agreed that they would be of great value in training raw troops in such an emergency. But those officers did not agree that troops trained under the new Regulations would be as good as those trained according to the old.

The fundamental difference between the old and new Regulations is the difference in their chief purpose. The chief purpose of the new Regulations is *quickly* to train troops so that they can be moved from place to place, and sent into battle. The chief purpose of the old drill was to discipline men, to inculcate on the parade ground a subconscious obedience to orders so strong that on the battlefield it insured obedience even when obedience meant death. Even the most-enthusiastic believers in the more-modern system admit that it lacks the disciplinary value of the old drill.

Though performed smartly by Captain Shoemaker's company of Twelfth Infantry Regulars, the new drill lacked the snap and impressive precision of the old. Performed by less perfectly drilled men, it could, I think, easily degenerate into downright sloppiness. Enlisted men, like their officers, believe in its value for emergency training, but many of them regard it as too easy for professional soldiers.

ANOTHER objection made to the new Regulations is that the column of threes will lengthen the already long column of an infantry division, and make it very difficult for the divisional commander to get enough troops in action in a meeting engagement to insure success before nightfall.

Standing firm against all these objections, however, is the all-important fact that the new drill is easily and quickly learned!

Every important improvement in the weapons of war forces a change in infantry tactics and formations, and, sooner or later, these tactical changes are reflected in the Regulations. Before the World War the American infantryman fought with just two weapons—rifle and bayonet.

If an American infantry regiment went into battle today it would fight with no less than ten weapons—tanks, 37-mm. guns, light howitzers, machine guns, rifle grenades, automatic rifles, rifles, hand grenades, pistols, and bayonets.

The wartime Tank Corps has been washed out and the tank now is an infantry weapon, operated by specially-trained infantrymen.

The infantry regiment of today, with a war strength of 3,106 and a peace strength of 1,217 men, consists of a regimental headquarters company, a service company, a howitzer company, and three battalions. Each battalion consists of a headquarters company, a machine gun company, and three rifle companies. The howitzer company is organized in three platoons, each platoon operating a light howitzer and a 37-mm. gun, and in action one platoon is attached to each battalion. Animal transporation is used freely, and many a doughboy has to be an expert in some activity, such as riding, driving a team, or mule leading.

OPINIONS vary as to the desirability of the new Regulations for close-order drill, but every army officer I talked with thought them just the thing for extended-order drill to teach the mechanism of actual fighting.

The squad column, with the squad leader at its head, is the basic unit of the new extended-order drill. Squad and section leaders, corporals and sergeants, are made more important by the new Regulations.

When the command "As skirmishers!" was given the men of each squad deployed in an irregular wedge, with intervals of about five paces between men. Anything even resembling a straight line was avoided. Then the squads advanced by infiltration—small groups, with the automatic riflemen among the first to go, working themselves through gaps in the supposed enemy's fire.

Then the rifle section advanced in a line of squads covering an average front of 150 yards. This was varied by a triangular formation, in which the center squad was either forward or back.

Something new to me was the anti-aircraft formation. A section was in column of threes when its leader shouted, "Airplane!" The outside squads sprinted to either side of the road, and formed irregular semi-circles. The men of the center squad jumped into ditches on either side of the road. The result was a scattered group of soldiers who would make a poor target for an airplane machine gunner or bomber.

Yes, the doughboys have gone modern!

BLINDING HEADLIGHTS DOOMED BY TESTS

(Continued on page 37)

other hand, are used to light up the foreground. Piece by piece, the headlight beam is built up by selecting tiny filament images and bending and guiding them by the proper lens thickness.

The one-eyed car is a familiar pest wherever there are roads. Often the driver does not know that one of his headlights is out. For this reason, lighting engineers recommend the use of small metal reflectors on the top of each lamp. These catch a small amount of the light and direct it back to the driver as a telltale. Often a curved rod of glass or quartz is used for the same purpose.

ALTHOUGH there is little that the motorist can do about the other fellow's one-eyed car, he can protect himself by carrying a supply of bulbs and using them the minute he finds that one of his own headlights has ceased to function.

Bulb burns-out, it is found, occur most frequently during the winter. This may result from the high voltage caused by an effort to increase the charging rate to overcome increased battery drain or by the higher resistance of the storage battery when it is cold. Also, an unlighted filament, especially an old one, is more brittle in cold weather and may snap with the vibration.

Even though the headlights are the real eyes of the motor car traveling dark roads, they are by no means the only important piece of lighting equipment. Tail and stop lights are also essential for safety. An increasing number of cars are being equipped with two stop lights. In addition to being more prominent, they serve to mark the boundaries of the car.

When two stop lights are used, they can be wired to serve as turn indicators. Flashers operated thermostatically or by pendulums or similar means are connected into each stop light circuit. When the driver wants to turn left, he presses a button and the left stop light blinks on and off rapidly. For a right-hand turn, the right stop light serves as the signal. Both lights operate steadily when the brakes are applied.

This system has been found to be simple and is superior to most of the other direction-indicating schemes that have been proposed. The device controlling the signals should be semi-automatic in operation so that it will switch off when the turn has been made and prevent misunderstanding on the part of other drivers on the road.

Countless tests, made in dense fogs on dark roads, have shown the way to better driving in the fog. Best results are obtained when a spot or driving light, placed in front of the car and close to the road, is used. Like smoke, fog is less dense close to the surface of the ground.

FRONT compartment lights, step lights, trouble lamps on wired reels, and door-operated dome light switches are useful accessories for the modern passenger car and their use is becoming general.

Fender lights that turn on automatically when the headlight beams are depressed are an added safety feature. Besides serving as boundary lights in driving and parking, they act as pilots to tell the driver that his passing lights are on.

While the motorist can do much in the way of improving his lighting system mechanically, he can do the most by following the simple rules of road courtesy. If the light dimming habit were universal and headlight adjustment compulsory, lawmakers might permit the use of more powerful lights. Until then, many automobile lighting improvements must remain laboratory curiosities.

OPERATIONS ON HUMAN BRAIN

(Continued from page 26)

original operation consists in removing the top of the skull and replacing the bone with a heavy plate of special celluloid. This somewhat changes the shape of the skull and eliminates the pull at the attached points. The scalp grows over the plate and fibers of the dura, growing through tiny holes in the thick celluloid, anchor it firmly in place. To date, Dr. Ney has performed this operation upon seventy-four epileptic patients, with remarkable results.

AT ONE point on the brain, a speck the size of a pinhead produces alarming symptoms; at another point, a tumor becomes as big as a fist before it gives serious trouble.

A few years ago, a young tennis player of my acquaintance began having trouble with his serve. He couldn't seem to throw the ball into the air twice alike. That was the only thing he noticed wrong with himself, he told me when he came for an examination. Yet study of his case revealed that the cause of his trouble was a tumor on the brain about the size of a hazelnut and almost as hard.

When it was removed, the player's difficulty disappeared. If the tumor had not been discovered in this unusual manner, it might have grown to a size that would have made its removal most difficult, or even impossible. Surgeons today are more than ever on the alert to discover and remove such tumors as early as possible.

Not many years ago, an abscess of the brain was considered hopeless. Even when an operation was performed, at least eighty-five per cent of the patients died. Today, improved methods and earlier diagnosis save the lives of an increasing number of such sufferers. There have been cases in which an abscess of the brain has been cured simply by tapping through the skull.

An instance of this kind occurred in Cleveland, Ohio, three years ago. A six-year-old boy was running down the street when he fell and the point of an umbrella punctured his skull. Infection, carried into the brain, developed into an abscess.

By drilling a small hole through the skull over the infected spot, Dr. Albert T. Steegmann, the surgeon in charge, inserted a hollow needle attached to a syringe and drew off an ounce of pus. Immediately the boy began to improve. On alternate days, this tapping was repeated until no more pus could be drawn off. As a result the child made a complete and permanent recovery.

Approximately ten per cent of all cases of insanity grow out of injuries to the head. It has been proved, in a number of instances, that normal persons have been turned into criminals as a result of a blow that injured the brain. Curiously enough, the most serious symptoms of brain injuries often fail to appear until weeks after an accident.

FOR instance, take the queer case of a wandering bullet found in the brain of a negro bricklayer. A few days before he was rushed to a hospital, after being shot through the back of the skull, a fire had destroyed all the X-ray equipment. It was impossible to find the lead and the surgeons dared not operate without knowing exactly where they would find the bullet.

In spite of the fact that the missile was left within his skull, the negro apparently recovered and left the hospital. Seven weeks later, however, he began to go blind. An X-ray picture showed that the bullet had wandered from the course it had taken on entering the skull and had been carried to the center of vision at the back of the head. It was removed and the patient regained his sight.

At the last meeting of the American College of Surgeons, Sir William I. de Courcy Wheeler, famous Irish surgeon, told of removing a bullet that had been in a patient's brain for four years. The lead had lodged in the association area impairing the victim's memory, vision, and hearing, all of which were restored by the operation.

In another case, seventeen years passed before the serious results of an accident became apparent. A falling brick fractured the skull of an eleven-month-old baby boy. Convulsions followed for a time, then passed away. At the age of seventeen, the boy began to have epileptic fits.

THROUGH an amazing piece of surgery in which part of the boy's thigh was transplanted to act as a cushion for his brain, Dr. Charles H. Harris, of Fort Worth, Texas, restored him to health.

He found the fits were caused by pressure of the fractured skull-bone on the brain. Making a horseshoe-shaped incision, nine inches long, which extended from just behind the left ear around the back of the head, he lifted the section of the skull which was causing the trouble. Under it, to act as a cushion and eliminate the pressure, he placed a strip of fatty membrane cut from the patient's thigh.

The operation was a complete success. The convulsions disappeared and the boy returned to school. Another dramatic feat had been added to the long list recorded in the annals of brain surgery.

SEEK DEEP-SEA FISH WITH FIVE-MILE LINES

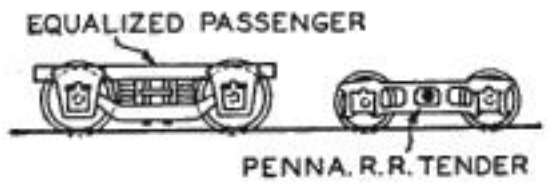
WITH fishlines five miles long and colored lights for bait, members of the Johnson-Smithsonian deep-sea expedition are angling in the Puerto Rican deep, a five-mile hole in the ocean floor north of the island of Puerto Rico, for strange forms of sea life never seen by human eyes. Besides the light-baited lines, they will lower to great depths, a trap, twenty-five feet in diameter and made of iron pipe and wire netting, which will have four compartments, each with a different-colored light for bait. The fish which live in the total darkness and under the tremendous pressure of great depths carry phosphorescent lights of their own and are believed to signal to one another by means of them. Another study that will be carried on by the expedition will be an investigation of the ocean floor in the deep. Six-foot cores are to be bored out of the seabottom by means of a special apparatus in order to determine the composition of the ocean floor at this point.

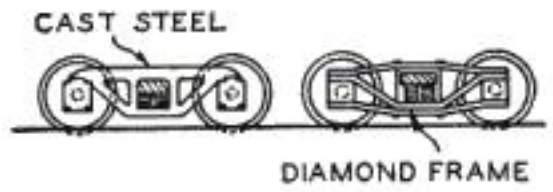
AMERICAN COW GIVES FARMER BIG INCOME

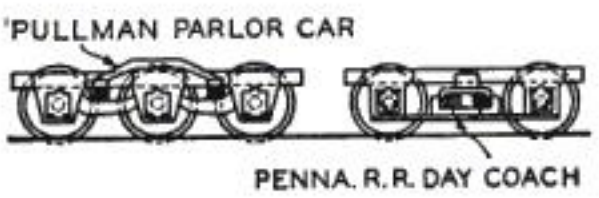
IN 1932, the cow was queen of the American farm. Dairy products, a recent bulletin of the U. S. Department of Agriculture reports, for the first time led all types of agricultural income. Cotton, wheat, and live stock at various times in the past have been greatest revenue-bringers to farmers. Last year, milk and other dairy products accounted for $1,180,000,000 of the total farm income, with live stock ranking second with a record of $1,122,000,000. The income from cotton dropped seventy-two per cent from the 1929 figure, and the income from grain fell off seventy per cent.

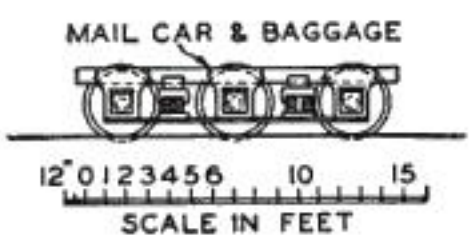
CHART OF AMERICAN TRUCK TYPES

—'O' GAGE—

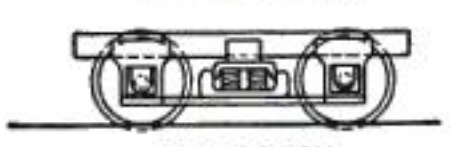


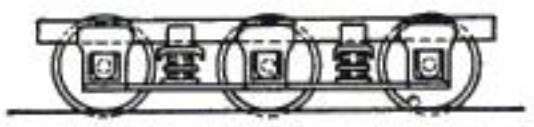


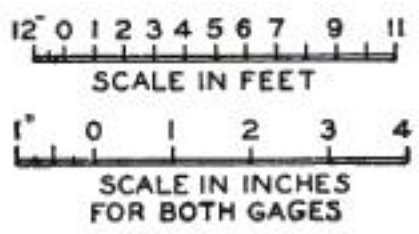




—'1' GAGE—







Railway car trucks drawn to scale for those model makers who build their own equipment

CHART AIDS IN BUILDING MODEL CAR TRUCKS

MODEL railway engineers who are interested in the construction of rolling stock will find the accompanying chart of assistance. It shows the standard American truck types in "0" gage and No. 1 gage, drawn accurately to scale. Constructors who require the exact scale—that is, those who wish the parts shown full size—can have the chart photostated up to the actual size required and then use the chosen diagram as a template in making the trucks. This will save redrawing.

Diamond frame trucks are the simplest to make. Strips are sawed out and then bent to the gage sizes, and the necessary holes are drilled for clamping the parts together where they are to be soldered. The wheels can be made by the simple method of spinning described on page 87.—J. G. M.

LONGER LIFE FOR YOUR CAR VALVES

(Continued from page 58)

serviced now and then. Trouble is, most car owners don't think of the valves until something happens. If you grind your valves every time you scrape carbon, they'll last just as long as any other small moving part.

"The important thing is to be sure that the valves always close tightly against the seats. If they do, they'll be cooled off between explosions and won't burn so easily. That's why a weak valve spring is just as bad as a poorly ground valve—the valve doesn't close tightly."

"I never thought about the valve springs," Chet admitted. "How do you know whether a spring is weak?"

"By the length," Gus told him. "If one spring is shorter than the rest, it'll be weaker than the rest. Of course, you can tell for sure by rigging up an ordinary weighing scale like an iceman uses so it'll measure the tension of the spring when it's compressed."

"Gosh, this valve business is kind of complicated," exclaimed Chet. "I thought valve grinding was one of the jobs any car owner could do."

"Valve grinding's easy," Gus assured him, "if you'll take enough time to do the job right. Remember though, too much grinding is worse than none at all."

"That's O. K., but how do you know when the job is finished?" Harmon inquired. "I ground those valves a lot just to be on the safe side."

"Ever hear of Prussian blue?" Gus asked as he reached for a small can on the repair bench. "It's the stuff machinists use to test a fit. Smear a little on the valve face, press it down on the seat, and give it a twist. If the valve's a good fit, the blue will be smeared off in a circle around the face. And if you haven't Prussian blue, mark six or eight pencil lines across the valve face."

"I suppose the wider you can make the valve seat the better it is," Chet interrupted.

"Nope, you're wrong there. The best kind of a valve seat is a fine, narrow edge. It'll last longer than a wide one and won't offer so much surface to collect carbon particles that may keep the valve from closing.

"Speaking of carbon, there's one point the amateur mechanic always seems to forget when he is refinishing valves—the valve stems. Be sure they're clean and free from crusted carbon before you put them back. A square of number zero or zero-zero emery cloth will polish them up in fine style."

"Say, Gus," Harmon said, "why don't automotive engineers figure out some way to make the valve mechanism on a car safe and sane? They ought to be able to beat the overheating and warping trouble."

"They have in a way," Gus replied. "Some of the new 1933 models have special steel ring inserts for the exhaust valve seats and they're using alloy steel valves that stand up better under the heat. There's one hitch, though. Some of the new alloy steel valves are so hard they're not affected to any great extent by ordinary valve grinding compounds. If they're in bad shape they have to be reconditioned on a regular grinder and then lapped with compound."

"Well," sighed Chet as Gus paused, "I guess I'm hooked. Fix my car up and phone me when it's ready."

"O. K., boy," nodded Gus. "Want me to do the job right and put in new valve-springs?"

"Give it the works," Chet told him. "Put in anything that'll make it run again. Put in some valves and valve seats that'll never wear out, if you can."

Gus smiled. "That's an order I'm afraid no one can fill—yet."

Scientists Unite in War on Earthquakes

(Continued from page 13)

has taken on a new and urgent importance.

Data assembled through laboratory tests will be combined with study of structures destroyed by the California shocks to answer the question: What kind of a building is best fitted to survive an earthquake? This is the problem scientists at the Massachusetts Institute of Technology and the two California institutions have been trying to solve by means of elaborate tests.

On platforms mounted on steel spring columns, tiny reproductions of buildings are being subjected to miniature quakes which are expected to reveal the weaknesses of present construction and the requirements of quake-proof structures.

At Stanford University, a heavy metal wheel, swinging like a pendulum, periodically strikes the platform in imitation of the shock of slipping rock strata. Other laboratories use heavy, off-center fly-wheels to shake the testing floors. In the earthquake room at the California Institute of Technology, I saw several kinds of buildings, reproduced in miniature, dance and vibrate in the grip of mechanical quakes while delicate instruments recorded the minute stresses and strains of the tiny buildings.

One of these complicated testing mechanisms looked like a cross between a stock-ticker and a large mechanical toy. It consisted of a small electric motor, a little model of a six-story building, four strips of paper, four electric coils, and a queer irregular-edged board. Professor R. R. Martel, in charge of the experiments, started the electric motor. It drew the paper strips past tiny metal points at each floor of the miniature building. Then he inserted the board in a slot at the base of the testing machine. Its wavy line represented the vibrations of an earthquake and produced pulsations that shook the little structure.

Instantly there was a sound like the buzzing of a thousand infuriated bees. It was produced by sparks jumping between the high-tension points. Professor Martel explained that these sparks punch holes in the paper. The pattern formed on the moving strips by these holes shows graphically the movement of the various parts of the building and indicate the stresses the laboratory quakes produce.

With such models, scientists are verifying mathematical formulas that will aid architects to build sounder structures in earthquake regions. New formulas may be possible when the data collected by the government heavy-duty seismographs have been made available for use in the calculations. Heretofore the motions of the laboratory quakes have been admittedly only an approximation of the vibrations resulting from real tremors. Moving beams of light, recording on white ribbons of sensitive paper the movements of the earth during the California shocks, experts hope will enable them to discover a trend that reveals the general characteristics of all earthquakes.

A special phase of the researches in the laboratories concerns vibrations set up in buildings by earth tremors. If a building gets in tune with the earthquake vibrations, it will crumble, just as a bridge will collapse if an army marches across it in step. But does the earthquake stay in tune once the ground begins its tremors? The seismograph records will be studied to find out. At the California Institute of Technology, special tests with cross-bracing have been carried on with model buildings to discover ways of overcoming earthquake vibrations in various types of large structures.

Other experiments are under way to discover not only how elastic a building must be to withstand the earth's movements in three directions but also how rigid it must be to pull itself quickly back into shape.

The worst type of building for an earthquake zone, according to the famous American architect, Frank Lloyd Wright, is one with a steel framework, curtain walls of masonry and floors built into them for support. A structure with a low center of gravity, shallow foundation and a light roof, he says, has the best chance of surviving the shocks of an earthquake. One of the buildings designed by Wright is the Imperial Hotel at Tokyo, Japan. It was one of the few structures that withstood the quake of 1923.

Will we ever be able to predict the coming of earthquakes as we now predict storms? Many scientists believe we will. As the tremors are caused by straining of the earth's crust, we may be able to watch the progress of strain in the surface rocks and thus learn when and where the crust will snap. Plans for measuring such strain as it accumulates with the passing of time are now being worked out.

Another line of research concerns the influence of the weather and electrical phenomena upon earthquakes. Some scientists believe that the changing pressure of the air upon different parts of the globe is the natural phenomenon that sets off the quake.

In the summer of 1925, when the Santa Barbara tremors occurred in California and shocks were felt in other parts of the United States, it was noted that the weather was remarkable for its humidity, high barometric pressures, and its frequent thunderstorms. Electrical disturbances originating far down in the earth's interior are thought by many geologists to control the snapping of the earth's crust. Such disturbances, accompanied by marked climatic changes, occur in violent outbursts that come in ten or twelve year cycles. Sun spots are also linked to earthquakes by many scientists.

A world-wide chain of observation depots for the collection of weather and electrical data, which can be compared with astronomical and seismological facts collected by other observatories, would be of infinite value in increasing our understanding of quakes.

Only in recent years has there been anything like systematic, scientific observation of these tremblings of the earth. Before earthquakes can be conquered, they must be understood. In the wide-spread attack upon the mysteries in connection with them, which has been stimulated by the recent disaster in California scientists hope to go far in protecting mankind from their menace.

Mysterious Under Sun

ONLY lucky aviators and mountain climbers have seen the strange phenomenon of the Under Sun, pictured in this striking photograph. It occurs when the sun is reflected from clouds formed of tiny ice particles. To see it the observer must be above such clouds. This photo, taken from the highest peak in the Bavarian Alps, shows the nature of the image

How to Tell Time by the Stars

(Continued from page 47)

observer knows that the clock has lost a tenth of a second. He accordingly regulates it to run slightly faster, and applies the correction to the time signals sent out by radio and telegraph.

This operation does not require the elaborate zenith telescope of an observatory. You will find it interesting to check the accuracy of your watch yourself by observing the arrival of some star at a certain point each evening for two or three days running. A star near the celestial equator is the best to take. In other words, a star that crosses the sky somewhere near the overhead point. You should not, however, try to observe it at the zenith or meridian as the astronomer does. Instead, wait until the star disappears behind a tall building or hill on its way down the western sky.

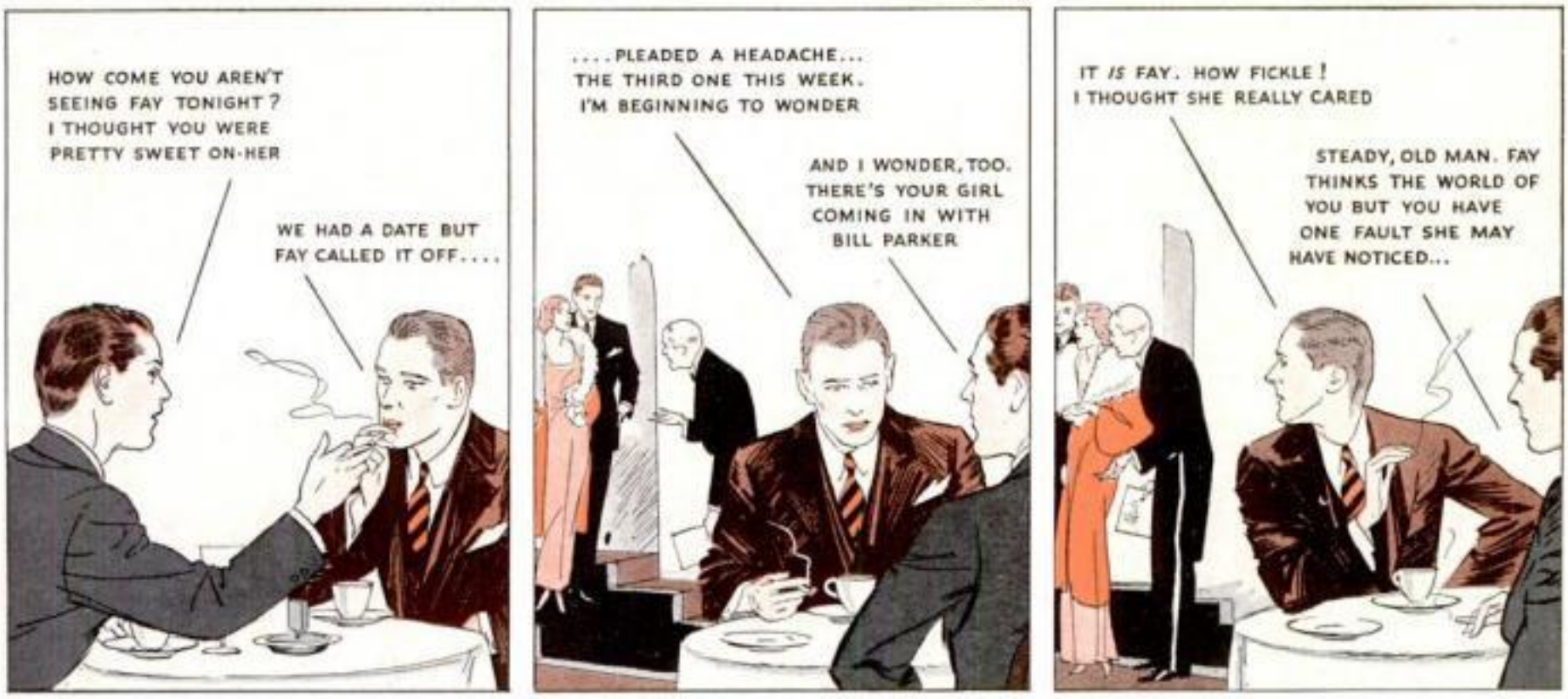
To note the time of the star's disappearance as accurately as possible, you should establish some sort of a backsight. A pin stuck into a window sash will do. The young man in the picture on page 51 is using the point of a triangle of cardboard fastened to the sash. He keeps the chosen star at the point of the triangle, and, watch in hand, notes that the star vanishes behind the building at twenty-one minutes after nine. The next night it *should* disappear at seventeen minutes and four seconds after nine—if his watch is correctly regulated.

But he finds that the star goes out of sight at seventeen minutes and fourteen seconds after nine. He therefore knows that his watch is running ten seconds fast in twenty-four hours. He pushes the regulator a little way toward slow, and awaits the next evening's observation of the star to see whether his adjustment of the watch's regulator has put it in harmony with the star.

A word of caution is needed in connection with this watch regulating experiment. Be sure that the star you select to use is not a planet. If you should unknowingly time the disappearance of Venus, Mars, Jupiter or Saturn, the amount that the planet moves in its orbit during twenty-four hours would spoil the accuracy of your whole observation and upset your time calculation so you could not regulate your watch.

The next article will show how to use the sixteen stars you have marked in your umbrella sky in finding the principal star groups in view at the season, and how to construct a new kind of revolving star map that will be good in any month of the year.

WHY FAY WAS FICKLE — by Timmins



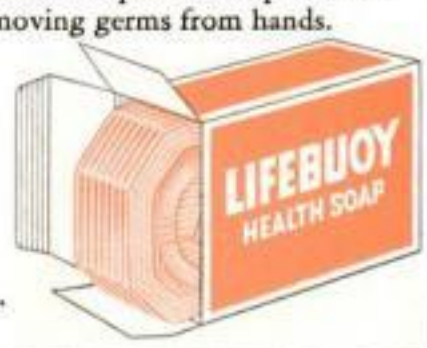
You can't be too careful about "B.O."

(body odor)

DON'T FOOL yourself about such a serious matter. You cannot afford to take chances with "B.O." (*body odor*) at any time of year. Every day—rain or shine, warm or cool—pores give off at least a quart of odor-causing waste. Bathe regularly with Lifebuoy. It is so *different* from ordinary toilet soaps that it's in a class by itself. Lifebuoy's clean, refreshing, quickly-vanishing scent is your assurance of *extra* protection. Its creamy, hygienic lather purifies and deodorizes pores—stops "B.O." Helps protect health, too, by removing germs from hands.

For a beautiful skin

Cleanse your face thoroughly every night with Lifebuoy's bland, pore-purifying lather. Millions follow this simple plan. And their complexions fairly sparkle and glow with radiant health and clearness.



ADVICE TO SHAVERS — by J.F. HART

How to get smooth, long-lasting shaves

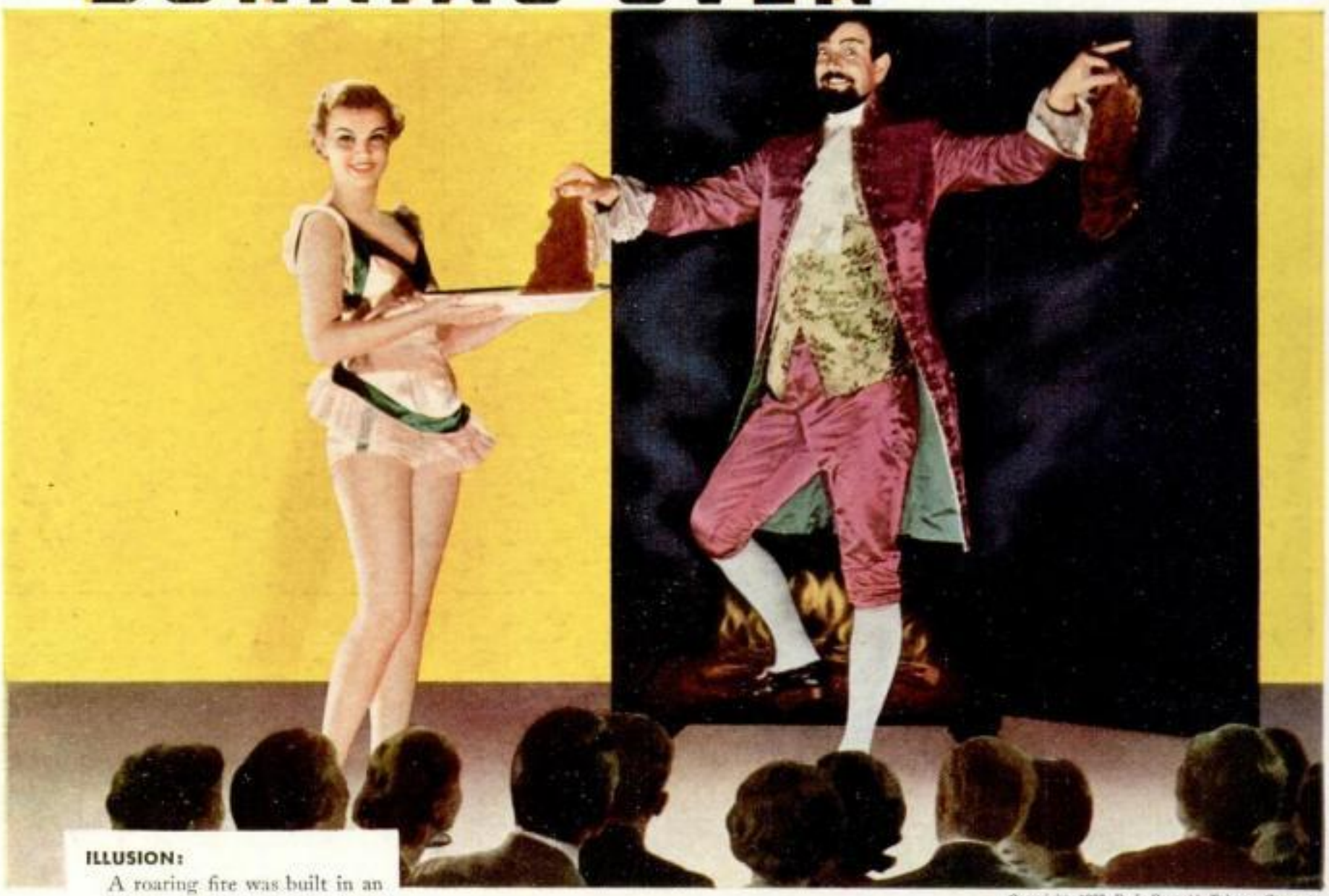
This extra-moist lather wilts tough beards—soothes the skin

THERE'S NO trick to getting a clean, lasting shave if you use the right lather. Light, bubbly, quick-drying lather won't do. But Lifebuoy Shaving Cream lather holds 52% more moisture. It soaks the toughest whiskers soft—extra soft—so they come off clean as a whistle.

You get a smooth-as-silk shave that lasts all day. And it soothes and protects the skin while you shave—leaves it soft, pliant, refreshed afterward. Economical, too—a little goes so far. Try it. Get the big red tube at your druggist's. Or write for a free trial tube to Lever Brothers Co., Dept. T-145, Cambridge, Mass. (*This offer good in U. S. and Canada only.*)

BURNING OVEN

STEAKS COOK BUT THE MAN LIVES..



ILLUSION:

A roaring fire was built in an oven...the temperature rose to 600° F. Into the oven walked the "fire" king, M. Chabert, carrying several raw steaks. A few minutes later the doors were flung wide and out he stepped...safe and sound...with the steaks thoroughly cooked.

EXPLANATION:

Heat rises. When Chabert entered the oven he hung the steaks *above* the fire, then dropped to the floor at the *side*, covering his head with a hood made from his shirt. He breathed through small air holes in the floor.

IT'S FUN TO BE FOOLED ...IT'S MORE FUN TO KNOW

"The Burning Oven" is an old illusion which has played a leading rôle in cigarette advertising. Its modern name is "Heat Treatment."

EXPLANATION: All cigarette manufacturers use heat treatment. The first Camel cigarette was manufactured under the heat-treating process. Every one of the billions of Camels produced since has received the necessary heat treatment.

Harsh, raw tobaccos require intensive processing under high temperatures. The more expensive tobaccos, which are naturally *mild,* call for only a moderate application of heat.

It is a fact, well known by leaf tobacco experts, that Camels are made from finer, MORE EXPENSIVE tobaccos than any other popular brand.

Try Camels...always fresh, in the air-tight, *welded* Humidor Pack.

KEPT FRESH IN THE WELDED HUMIDOR PACK

NO TRICKS... JUST COSTLIER TOBACCOS

IN A MATCHLESS BLEND